March 2016

Development of a Multimedia Courseware on Pre – Mathematics Skills for Kindergarten Pupils with Autism

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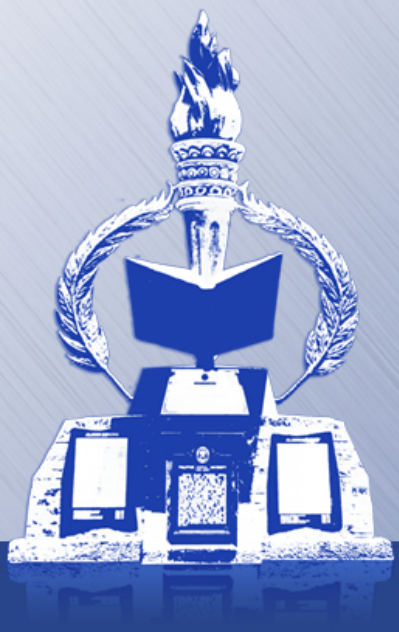

DEVELOPMENT OF A MULTIMEDIA COURSEWARE ON PRE – MATHEMATICS SKILLS FOR KINDERGARTEN PUPILS WITH AUTISM

A THESIS

Presented to

the College of Graduate Studies and Teacher Education Research

Philippine Normal University

Manila

In Partial Fulfillment

of the Requirements for the Degree

MASTER OF ARTS IN EDUCATION

With Specialization in Special Education

(Teaching Children with Intellectual Disabilities)

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March, 2016

ABSTRACT

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Title:	**Development of a Multimedia Courseware on Pre-Mathematics Skills for Kindergarten Pupils with Autism**
Keywords:	**Multimedia** **Courseware** **Pupils with Autism**
Degree:	**Master of Arts in Special Education**
Specialization:	**Teaching Children with Intellectual Disabilities**
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The purpose of the study was to develop a Multimedia Courseware on Pre-Mathematics Skills for Kindergarten Pupils with Autism using the developmental research method and utilizing the Analysis,Design,Development,Implementation and Evaluation (ADDIE) Model. The content of the courseware included all the pre-mathematics skills from the Department of Education Curricular Framework for Kindergarten Pupils with Autism (2012) namely; arranging objects in the order of size and length and locating positions, naming coins and counting orally.

The study specifically sought to 1) identify the content of the multimedia courseware for pupils with autism; 2) design the multimedia courseware based on review of previous studies and suggestions from the experts; 3) develop a multimedia courseware; 4) evaluate the multimedia courseware through experts' judgment and actual try out; and 5) finalize the multimedia courseware based on evaluation results.Findings suggested that much of the pre-mathematics skills should need to be worked on among pupil with autism. The study likewise focused on the learning characteristics, review of design considerations from previous studies and suggestions from the experts in design and development of multimedia courseware. Suggestions and recommendations from the evaluators and actual try out were used to finalize the Multimedia Courseware.

The following findings were drawn from the study: all the pre-mathematics skills from the curriculum were the content of the multimedia courseware ; the autism 's characteristics , previous studies on courseware development and suggestions from experts were necessary to design and develop a multimedia courseware ; the multimedia courseware was highly acceptable as a supplementary material and that its try out had showed improved learning behaviors among pupils with autism.

With the given findings, this study concludes that: A complete multimedia courseware is needed by special education teachers. Also, a multimedia courseware could be designed, developed and finalized through triangulation of information from autism's characteristics, previous researches, experts' evaluation and actual try out.

Given the scope of the study and the process it went through, the following recommendations are proposed: 1) A similar study be conducted with more participants and those with other exceptionalities. 2) A multimedia courseware that covers other subjects or learning competencies be developed.

ACKNOWLEDGEMENT

In the researcher's drive to come up with this manuscript, many individuals were involved whom the researcher would like to acknowledge for without their inspiration wisdom, assistance, and valuable time he would not have completed this endeavor.

Dr. Fortunato G. Vendivel Jr. , thesis adviser, whose expertise in the field of Special Education , Research and Statistics is really an advantage. And whose generosity, kindness, and persistent encouragement had motivated the researcher to strive more;

Prof. Emilio F. Aguinaldo, thesis co-adviser, whose knowledge in the field of Information Technology helped the researcher overcome the technical issues that were encountered;

Dr. Julieta A. Gregorio, professor of the Philippine Normal University, whose kindness on lending relevant materials as well as her expertise on Special Education and Early Childhood Education inspired the researcher to pursue with his field of study;

Dr.Zenaida Q. Reyes,Dean of the CGSTER, whose consideration of the researcher's condition, helped a himto finish his thesis;

Dr.Teresita G. De Mesa, one of the panellists, for her steadfast inspiration and guidance, her selfless assistance to improve the paper, and her optimism, which deeply influenced the vision of the researcher;

Prof. Jingle L.Sergote, one of the panellists, who extended her suggestion in the improvement of the Multimedia Courseware ;

Ms. Maria Lina D. Sangradorand**Mr**. **Arvie S. Andal** co – teachers, who had given advices on resource management;

To the **researcher's family**, whose been an even greater source of motivation

towards the completion and success of this study;

Above all, to **God Almighty**, the foremost source of wisdom and knowledge to

finish this research work.

Thank you very much.

TABLE OF CONTENTS

PAGE

Chapter 3 Research Methods

Chapter 4 Presentation, Analysis, and Interpretation of Data

Chapter 5 Summary, Conclusions and Recommendations

LIST OF TABLES

LIST OF APPENDICES

CHAPTER I

THE PROBLEM AND ITS BACKGROUND

1.1 Introduction

Do students with autism really have a world of their own? If so, how can they be engaged and motivated to learn academic skills? How do they process information? What can be done to help them in their academic endeavor? These puzzling questions linger on a teacher's mind when seeking for strategies that would help in addressing the behavioral and academic concerns of students with autism.

Autism refers to a condition characterized by severe and pervasive impairment in several areas of development: reciprocal social interaction skills, communication skills, stereotyped behavior, interests and activities (American Psychological Association, 2000). On the other hand, they are visual learners with good visual processing skills and detail focused processing skills (Happe & Frith, 2006).These unique traits, when capitalized, make them excel when compared to typically developing peers. Clearly, these positive points in terms of learning characteristics are essential when one wished to develop a suitable material for them. Balancing these contrasting characteristics has resulted in a painstaking task of teaching students with autism. Teachers and researchers are faced with the challenge of innovative approaches that would be appropriate to address the learning characteristics of students with autism.

In addition to this challenge, acquiring math skills in general are essential for

academic literacy. With their unique learning characteristics, students with autism usually excel in mathematics because they can arrive at a definite answer when they grasped the logic of the correct answer. However, they may also struggle in mathematics because of the sophisticated verbal instructions accompanied with it. The sensory processing difficulties they possess may affect how they grasp the information during instructional time (Dunn & Tomchek, 2007).

A teaching approach that has been put forward and gained attention is the use of computer based instruction. According to Hetzroni and Tannous, (2004), computer based instruction pertains to the use of computers to teach educational skills and also encourage the development of communication and language skill. They further emphasized that it can be used in enhancing the overall learning of academic skills. A more recent form of computer-based instruction is the courseware. Courseware refers to an educational material kit for teachers or trainers for students, commonly parceled for use with a computer (Veluz, 2015) However, though there is need for this approach in the education for students with autism, certain concerns were noted. According to Chong and Putnam, (2002) despite the availability of the said technology, few have access to it due to its complexity and high purchase price. They also asserted that technologies presently being used for autism had limited considered autism's unique characteristics. Furthermore, these technologies were designed for the typical users.

Similarly, in the Philippines, the above mentioned concerns were also true. Most of the technologies including courseware available in the market are intended for typical

students who have the normal learning ability. Veluz (2015) stressed why technology has an increasingly essential role in helping Filipinos with autism to live purposeful lives. Children at an early age today are much inclined to technology. Modification in the classroom instructions and activities is a process that involves new ways of thinking and developing teaching and learning practices. The Department of Education recommends the use of approaches that explicitly address the needs, instructional levels, and interests of the students. In consonance with curriculum modification (Department Order 72,s 2009, Appendix A, p. 141) and interest –based teaching, Department of Education encourages Special Education teachers to explore the use of new technologies to develop and enhance the overall skills of students with autism.

Some foreign and local initiatives were made already. Hansen (2014) compared the computer-based software to the traditional math teaching methods and encouraged further study on software design and ability matching to children with autism to identify features that makes a program effective them. In addition, Ramdoss, Lang, Mulloy, Franco, O'Reilly, Didden and Lancioni (2011) developed an individualized educational courseware program to teach a specific skill to a child with autism. Andal (2013) identified possible design considerations for developing multimedia storytelling courseware for preschool children with autism. The appropriateness of the courseware's design was emphasized. Andal (2014) also developed a multimedia courseware which was designed to help in introducing number sense to children with autism.

At present, Senator Claro M. Recto Memorial School Special Education Center

lacks technology- based materials that are suited to meet the needs of kindergarten pupils with autism. Special Education teachers use commercial books and other supplementary materials that are often not enough to deal with the behavior problems exhibited during instructional time. Thus, the unique characteristics of pupils with autism come to be one of the considerations in this research pursuit. Moreover, the researcher was driven by the determination to address insufficiency of materials for them. Likewise, help them attain a good pre-mathematics skills foundation with an appropriate supplementary material that suits their learning needs and characteristics.

1.2 Theoretical Framework

The study is anchored on different theories and assumptions, especially in terms of understanding the nature of pupils autism namely; Weak Central Coherence Theory, Impaired Theory of Mind Theory and Sensory Processing Difficulties Theory since a material should be suited to their unique learning needs .These theories provide the researcher better understand the behaviors associated with autism. More importantly, helped the researcher in the design and development of a more individualized and suitable supplementary material that could be used as part of the teaching and learning process. The study is also anchored on the adapted principles of Cognitive Multimedia Learning Theory suited to the perceived characteristics of autism.

The Weak Central Coherence Theory suggested that individuals with autism tend to sequentially process information by focusing on fine details of the stimulus causing them to

overlook the big picture (Frith 2003).This unique way of seeing things make them very good at examining fine details. McKenzie, Evans and Handley (2010) claimed that this processing style makes individuals with autism perform better in remembering facts and specific things. On the hand , they may struggle in understanding the facts when used in different contexts or situations. They prefer to have routine and structure when functioning in the environment.

The researcher explored the use of computer -aided instruction in the form of a courseware in response to these characteristics because the computer offer a predictable learning atmosphere for them. Silver and Oakes (2001) claimed that computer programs offer a predictable and stable avenue. Being visual learners, children with autism are characterized with good visual processing skills and detail focused processing skills despite their impairments that negatively impact their social interaction, communication and learning behavior. Tomorszki (2013) expounded that the computer‘s predictability employs visual presentation suited to children with autism’s visual learning skills. Davis,Otero, ,Dautenhahn, Nehaniv and Powell (2007) asserted the use of computer-aided instructions dominated by visual presentations as a design consideration for children with autism. The researcher also used actual pictures to enable better generalizations. Actual pictures also offered a clear visual depiction of the items. The courseware’s simplicity in both design options and functions makes it an ideal learning tool for pupils with autism. Specifically the courseware was designed to open one program at a time. Tasks and activities were isolated. Each finger tap or swipe produces a single action .And only allows separateand sequential

actions. The instructions to be performed are short for easier processing of information. Lastly, the sections in the courseware were structured for the pupils to have a knowledge of what he/ she is working on. Repetition was also employed in the presentation of the different features of the courseware.

Next, was the Impaired Theory of Mind Theory, which was originally proposed by Frith, Baron-Cohen and Leslie in 1985 offers an explanation why children with autism are not automatically programmed to think about the mental states of others and that the significant symptoms of autism like impairment in social interaction, communication and behavior could be explained by a failure to develop theory of mind early in life (Sansosti, Powell-Smith & Cowan, 2010). Consequently, individuals with autism often lack the interest to look at the human face and fail to look at the facial features that reveal emotions such as the eyes. As a result, they are unable to understand what other people think, feel and view the world differently than they do. For this reason, they may have difficulty distinguishing their own thoughts and feelings from others. Sterling and Dawson (1994) proposed that the lack of attention to the face of other people during opportunities of social interaction is one of the best early markers of future diagnosis for autism. Landa (2000) asserted that children with autism with impaired theory of mind have difficulty behaving in a socially appropriate manner. This characteristic was witnessed by the researcher in handling children with autism. There would be instances that a child with autism completely ignores if he had done something wrong. This characteristic made it difficult for a teacher to manage their behavior.

Designing the courseware in a way that would address the characteristics explained by the impaired theory of mind is a step to a tailor- fit material. Emoticons like happy and sad face to signal the correctness of the response within the courseware address the predictability issues and social deficit of children with autism. Relating it to the researcher's experience as a teacher for children with autism, using emoticon pictures as reinforcement to signal the correctness of response oftentimes could be effective for children because other than its visual appeal, children are used to this during instructional time in the classroom. Using motive questions as a cue within the courseware could also address the social difficulties by encouraging interaction with them.

The third theory that served as the guiding light of this study was the Sensory Processing Difficulties Theory, which views that individuals with autism may have sensory processing difficulties that may result to under or over reaction to stimuli (Lane, Young, Baker & Angley, 2010).They may perceive sound of a certain pitch to be unbearable or notice very faint sounds that others may not hear such as siren from a distance. Many children with autism may withdraw from certain stimuli due to the overloading of the senses (Attwood, 2007). In recognition this unique sensory processing profile, Andal (2013) pointed out that a courseware for these children should provide options for controlling the media or elements used in the courseware like sounds, brightness as well as the manner by which prompts will be presented. As it has been observed by the researcher in his experience teaching pupils with autism, there should be careful planning in the way materials or information are provided since there is a tendency to either over or under stimulate them.

Either way, the level of stimulation has an impact on their learning behavior.

With this in mind, design consideration in the multimedia courseware made the presentation simple by controlling the display of eye candies. The courseware‘s music was calming and the sound could be adjusted. The background color could be changed as well. These were done to address the difficulty a child with autism may encounter in processing the stimuli and information.

The three theories were used by the researcher to have an idea in the design of the courseware, as well as to have an explanation on how pupils with autism behave and learn early mathematics concepts. With their unique learning characteristics, children with autism usually excel in learning some mathematics concepts easier .Specially those that require separation. However, the sophisticated verbal instructions accompanied with it and the sensory processing difficulties affect how they understand the information during instruction (Dunn & Tomchek, 2007) .Ontario Ministry of Education (2007) emphasized that the sophisticated verbal instruction and the complexity of mathematical terminologies are confusing for children with autism’s language processing difficulties.

That last theory that had shaped the framework of this research was the Cognitive Multimedia Learning Theory by Mayer (2009), who defined multimedia as the simultaneous use pictures, words music, graphics etc. Mayer (2009) claims that people learn better from words and pictures rather than from words or pictures alone. Due to the different sensory preference of children with autism, the researcher adapted the principles enumerated by Gurney (2012) that possibly suited in the context of autism. First is the *segmentation* which

tells the multimedia lessons should be presented following the learner's pace segment than continuous whole unit. Second is the *personalization* which tells that learning is better when words used are presented in conversational style than a formal style in narration. Third is the *coherence* which tells that learning is better when necessary materials are only included. Text and graphics that are relevant materials were combined and aligned with the delivery of instructions. Fourth is *modality* which tells that learning is better with the use of printed text and narration, than graphics and printed text. Fifth is *multimedia* which tells that words and pictures encourage more than words alone. And last is *voice* which tells that learning is better when the multimedia messages are delivered using a friendly human voice than a machine generated voice. The adapted principles of Cognitive Multimedia Learning suited for children with autism presented the multimedia lessons in learner's pace segment. The courseware made use of conversational style of narration. The courseware observed that only necessary materials were included. Relevant text and graphics were combined and aligned with the delivery of instructions. The courseware also made use of printed text and narration. Lastly, the courseware also made use of words, pictures and friendly human voice in narration. The theories and studies cited above implied that a suitable learning material has an impact in the learning behavior of children with autism. The researcher emphasized that the primary consideration is the suitability to the unique learning characteristics and nature of children with autism. Understanding the characteristics and the theories underlying these difficulties is essential in the development of effective supplementary materials.

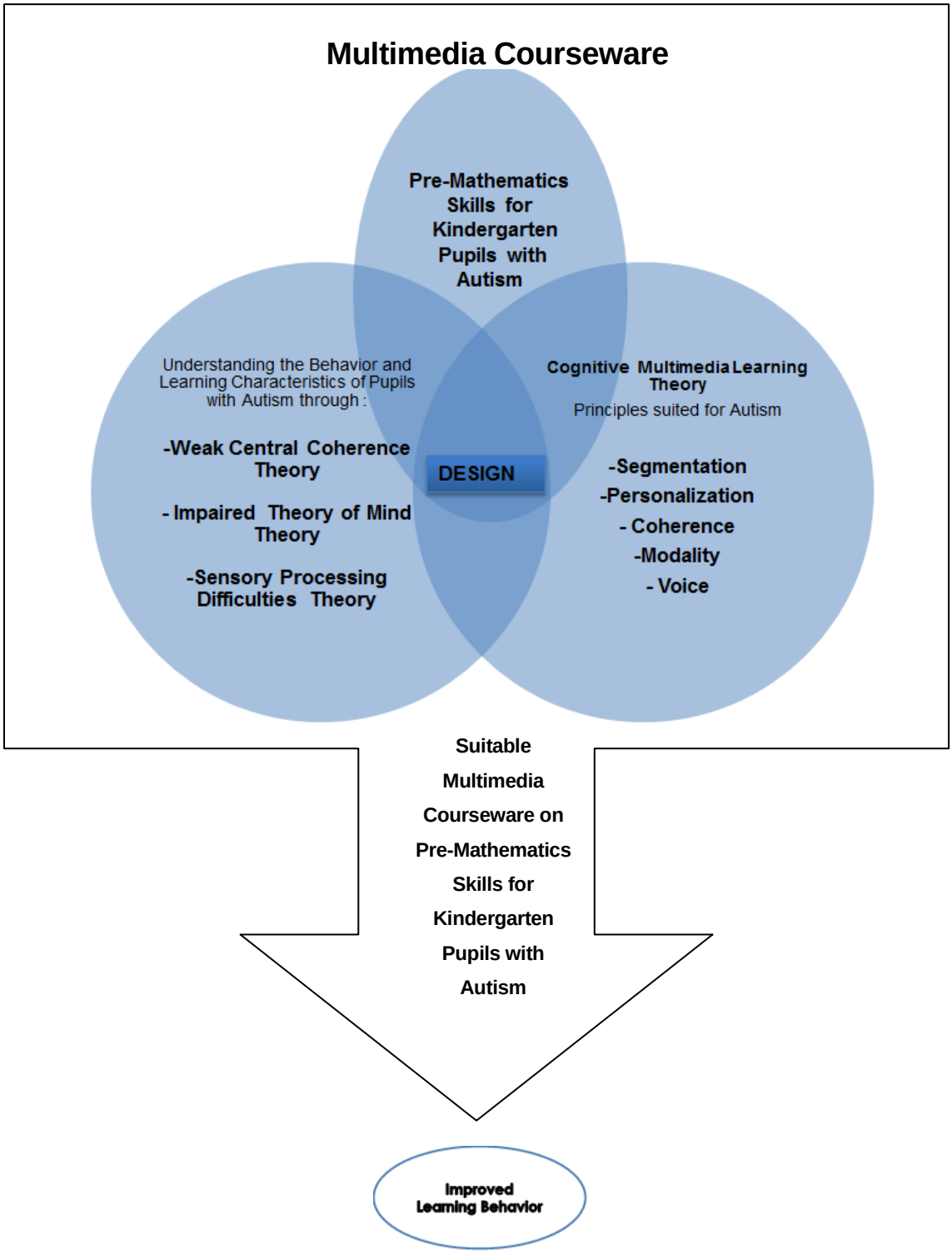


Figure 1.1 The Theoretical Framework of the Study

Figure 1.1 shows the theoretical framework of the study. It shows that the development of the multimedia courseware was based on the design grounded on theories on understanding the characteristics of autism and the adapted principles of Cognitive Multimedia Learning Theory suited for the said pupils .These theories were contained in the two circles. It also shows the pre-mathematics skills as its content on the other small oblong. Carefully designing the multimedia courseware based on the accounts mentioned earlier resulted to a suitable multimedia courseware on pre-mathematics skills for kindergarten pupils with autism which directs to its goal of having an improved learning behaviour.

1.3 Statement of Purpose

The general purpose of this study was to develop of a multimedia courseware on pre-mathematics skills for kindergarten pupils with autism. Specifically the study sought to achieve the following objectives:

1. identify the content of the multimedia courseware on pre-mathematics skills for pupils with autism
2. design the multimedia courseware based on review of design considerations from previous studies and suggestions from experts
3. develop a multimedia courseware
4. evaluate the multimedia courseware crafted by the researcher through:

   4.1 Experts' judgment (Special Education Teachers and IT Experts)

4.2 Actual Try out

5. finalize the multimedia courseware based on evaluation results

1.4 Significance of the Study

The developed multimedia courseware significantly contributes in producing suitable supplementary material for pupils with autism that is suitable to their specific needs and learning characteristics.

Likewise, this study would primarily benefit the following:

Special Education Teachers. The developed courseware can serve as a ready material for Special Education teachers in teaching pre-mathematics skills. It can help them expose pupils on educational technology.

School. This study can help the school have an additional contextualized supplementary material as resource. The school can share it to other Special Education centers as their additional learning resource.

Special Education Administrators and Curriculum Planners. The findings of this study could serve as inputs in identifying effective strategies for better implementation of the modified K to 12 curriculum for mathematics.

Parents. The developed multimedia courseware can be used by parents at home to teach pre – mathematics skills.

Future Researchers. This study can be a benchmark for developing other K to 12 aligned multimedia materials for pupils with autism for future research.

1.5 Scope and Delimitation of the Study

The study focused on developing and evaluating a multimedia courseware as it was used to teach pre-mathematics skills for pupils with autism. The study focused only on developing a multimedia courseware based on the pre-mathematics kindergarten level of pupils with autism and evaluated the suitability of the design for the aforementioned pupils. The said courseware is not a standalone program but a supplementary material that would assist the Special Education teachers in the teaching process.

The concepts included in the courseware which were derived from the adaptation of the Curricular Framework for Kindergarten Pupils with Autism (2012)

Furthermore, the participants for the preliminary and actual try out were limited to the class of selected pupils on the kindergarten level Autism class at Senator Claro M. Recto Memorial School Special education Center class which was operationally classified as being more capable of using the developed multimedia courseware.

The content evaluators who validated the PowerPoint version for the preliminary try out were limited to five (5) Special Education professionals; one (1) Education program supervisor in Special Education, three (3) school Special Education coordinators and one (1) early intervention program manager for pupils with autism. Five (5) Special Education teachers evaluated the content quality of the courseware.The said evaluators were also the contributors for the overall suggestion for the design consideration of the courseware. On the other hand, the technical evaluators were limited to five (5) Information Technology (IT) experts from De La Salle University-Lipa and

Systems Technology Institute (STI) College-Lipa. It can be noted that majority of the ideas and concepts in the design conceptualization came from the researcher. And the partner computer programmer handled only the technical matters in courseware development.

On the technical aspect of the courseware , it was also noted that the control of multimedia elements like sounds music and brightness were done outside the program because the courseware was made with the use of a multiplatform game development software to give way to its accessibility feature.

The study was conducted at Senator Claro M. Recto Memorial School –Special Education Center during the fourth quarter of school year 2014-2015 up to third quarter of school year 2015-2016.

1.6 Definition of Terms

For a clearer understanding of the terms used in the study, the following are their operational definitions:

ADDIE Model. This is a systematic process used in designing instructions and training programs. ADDIE stands for the five phases of the model, namely: Analyze Design, Develop, Implement, and Evaluate.

Assets . These refer to resources like graphics, sounds, contents, scripts to be used in courseware development

Autism. This refers to a condition characterized by severe and pervasive impairment in several areas of development: reciprocal social interaction skills, communication skills, stereotyped behavior , interests and activities .

Coding .This refers to the act of converting statements in a particular programming language.

Computer -Based Instruction. This pertains to the use of computers to teach educational skills.

Courseware. This refers to an educational material kit for teachers or trainers for students, commonly parcelled for use with a computer

Emoticon . This refers to image of a facial expression to express the feelings or intended tone.

Kindergarten. This refers to the initial entry level of a learner under the K to 12 curriculum.

Multimedia. This refers to the simultaneous use pictures, words music, graphics etc.

Pre- Mathematics Skills. These refer to the math readiness competencies included in the kindergarten K to 12 curriculum composed of number sense competencies.

Chapter II

REVIEW OF RELATED LITERATURE

This chapter presents the conceptual and research literature and relevant studies that helped the researcher shape his present study.

Understanding Autism

Autism refers to a condition characterized by severe and pervasive impairment in several areas of development: reciprocal social interaction skills, communication skills, stereotyped behavior, interests and activities (American Psychological Association, 2000). It is generally described as a spectrum of characteristics that is difficult to contain as its impact on an individual may be totally different from the other individual with the same condition (Friend, 2011). Consequently, having this condition should not be a limitation to live as a productive member of the society.

The characteristics of children with autism are seen and understood using the accounts given by three commonly used theories that are cognitive in nature, namely; Weak Central Coherence Theory, Impaired Theory of Mind Theory, and Sensory Processing Difficulties Theory. These theories give knowledge on how individuals with autism think and behave the way they do.

The Weak Central Coherence Theory suggests that individuals with autism process information by focusing on fine details or parts of the stimulus causing them to

overlook the big picture (Frith 2003). As a result, children with autism find it difficult to understand the whole picture of the situation they are in. They rely more on bit by bit processing of information, which makes it more difficult for children with autism to integrate details into meaningful pieces and look at it as a whole. For instance, they may be good in perceptual activities like puzzle game. On the other hand, they may have trouble in terms of interpreting words in long statements.

Another contributing knowledge to weak central coherence processing account was by Plaisted (2001) who claimed that the unique perceptual processing style in autism is better described in a perspective of reduced generalization .He stressed that the superior performance on block and figure design tasks can be explained as reduced processing of the stimuli and the environment that are laid. For example, in the embedded figures task, the target contains some features that have commonalities with the whole picture and features that define it. Hence, scanning the object pattern among the other patterns will be easier if the differences are more noticeable.

More so, McKenzie et al.,(2010) supported this account on the characteristics of autism and pointed that over dependence on such processing style makes students with autism perform better in memorizing facts and specific things. However, they may have difficulty in understanding the facts when used in a different contexts or situations. This instance may explain why they prefer to have routine and structure when functioning in the environment .They may dislike any change in their routine especially when the change comes drastically.

The Impaired Theory of Mind Theory was originally proposed by Baron-Cohen and Leslie .This offers an explanation why children with autism are not automatically programmed to think about mental states of others and the significant symptoms of autism like impairment in social interaction, communication and behavior (Sansosti et al., 2010). This theory pointed out that an ordinary individual has the cognitive ability to predict and explain one's behavior as well as that of the others .The term "theory of mind" (ToM) is used to describe the ability to infer and appreciate the mental states of other people (e.g., interests, beliefs, desires, perceptions, feelings and intentions of other people. Considering these characteristics in the current study could contribute in developing the mindedness among pupils with autism.

Osterling and Dawson (1994) proposed that the lack of attention to the face of other people during opportunities of social interaction is one of the best early markers of future diagnosis for autism. An account was given to why children with autism do not look pay attention to the gaze given by another person to guide their behavior. According to them, most children with autism whose mental and verbal abilities were well beyond the 4-year-old level find it difficult to answer questions upon seeking a scenario and answer within an emphatic perspective.

This was supported by Landa (2000) regarding why students with autism with impaired theory of mind have difficulty behaving in socially appropriate manner more so, problems understanding and appreciating the views and feelings of others. For example, a student with autism may talk about his experience in playing his favourite video game

during a math lesson regardless of whether the people around him are interested about the topic. Another instance is when a student with autism finds it hard to empathize and understand when the teacher cracks a joke, irony criticism and idiom in the class. The concept of impaired ToM is believed to explain the wide range social deficits displayed by students with autism. One example is the difficulty in topic maintenance when speaking and understanding the communicative intent of others and understanding nonverbal cues during interaction. They may also express impairment in understanding non literal language, such as joke, irony criticism. Lastly, the inability of some individuals with autism to recognize words that are associated with mental states (e.g. upset confused) to describe feelings can be accounted to the impairment of ToM. Difficulty with emphasizing or mindreading affected the different areas of functioning in an individual with autism, thus, a causal account for the existence of the triad of impairments.

This account was further explained by Frith (2003) who proposed that most children with autism fail to develop the ability to empathize on other people. Instead, they seem to have preference for information about the physical and observable characteristics rather than the psychological world. Consequently, they often lack the interest to look at the human face and fail to look at the facial features that reveal emotions such as eyes. Many of them also lack joint attention (e.g. the tendency to attend to something another person is looking at) and are unable to share another individual's interest and gain insight to his / her own feeling. As a result, they are unable to understand that individuals think,

feel and view the word differently than they do. For this reason, they may have difficulty distinguishing their own thoughts and feeling for others. This account on autism serves as one of the basis in understanding their behaviors which would consequently help in the design of the intended research output.

The last theory that offers an explanation of the characteristics of autism is the Sensory Processing Difficulties Theory. This views that individuals under autism may have sensory processing difficulties that result to under or over reaction to stimuli (Dun & Tomchek, 2007). These sensory processing problems may cause their escape or avoidance behavior to certain stimuli or seek certain forms of sensory stimulations which include auditory visual and tactile inputs. In addition, according to them, children with autism demonstrate some degree of sensory processing dysfunction. The repetitive behaviors demonstrated by a child with autism may be viewed as a coping mechanism to over and under stimulation when reacting to environmental stimulation which is visual, tactile and auditory.

In terms of auditory issues Chen, Rogers and McConachie (2009) described that the auditory processing concern of individuals with autism is displayed when they tend to over respond to auditory stimuli or on the other hand, may respond passively as if they did not hear anything. The tactile issues in individuals with autism can be seen as an over and under sensitivity to touch which translate to strange responses. This may be displayed when they react with extremely anxiousness, distractibility and fidgety with certain textures e.g. clothes, fond of movement activities like horseplay play and climbing.

Furthermore, they may also have unusual feeding patterns like the preference to crunchy food, unusual sensory inspection like mouthing of objects that they get hold initially.

They may have a high threshold for withstanding painful bumps yet they may be sensitive to clothing touching their skin (Chen et al., 2009). In addition, they may perceive sound of a certain pitch to be unbearable or notice very faint sounds that others may not hear such as siren in a distance. In addition ,many students with autism may withdraw from certain stimuli due to overloading of the senses .For example , a student with autism routinely cover his ears in order to block the intolerable sound of a fire alarm sounding during a fire drill .

According to Attwood (2007), unusual sensitivity to various stimuli typically occurs when responding to particular sound such as their name being called. They may also be able to endure pain and tolerate cold weather. In fact, some sensory stimuli may evoke pleasure such as cool air from the air conditioner. Generally, students with autism appear confused by and fail to understand why others do not have the same sensitivity level to stimuli that they themselves have. In addition, the way in which students with autism responds to different sensory stimuli whether fearful or not causes problems in daily life situations.

Several article readings explored the sensory processing of children with autism which further strengthen the claim that they perceive various stimuli differently. Rogers and Ozonoff (2005) discussed the existence of distinct processing patterns. They claimed

that children with autism typically have under-responsiveness to sensory stimuli also termed as hyposensitivity.

Lane et al.,(2010) enumerated three sensory processing subtypes namely; (1) Sensory-based inattentive seeking (SBIS),which is associated with behaviors displayed such as distractibility, inattention , over focused attention impulsivity;(2) Sensory modulation with movement sensitivity (SMMS) which is associated with specific movement function characteristics like having weak muscles and grasp poor endurance or fatigue; (3) Sensory modulation with taste and smell sensitivity(SMTS) which is associated with characteristics such as being hyper or hyposensitivity to taste and smell. They asserted the necessity of designing sensory-based interventions for students with autism that will address their different sensory processing issues.

These prominent theories helped the current study in understanding the evident behaviors and characteristics of pupils with autism.The knowledge on the way autism think and perceive things and the actual interaction with them serve as helpful information on understanding the.

Learning Characteristics of Autism

According to Happe and Frith(2006), there are still positive points that are worth to be looked at regarding the learning characteristics of students with autism Being visual learners, students with autism characterized with good visual processing skills and detail focused processing skills despite having impairments that negatively impact their

way of functioning in social interaction, communication and behavior . The localized processing enables them to have a detail-focused perception of given information which makes them capable of remembering the smallest detail of information that a typical person may not consider attending or remembering.

According to Luckevich (2008), students with autism also have strengths in memorization and reading. Such characteristics are proved by higher achievement score in test of nonverbal intelligence. Most most students with autism have excellent word recognition skills even with no formal instruction from school. For instance, they can read a selection in a fast pace but might not really understand its conceptual meaning. They may answer "wh" question but have a hard time answering the how. He further explained that such characteristics make students with autism excellent in perceptual activities such as puzzle and scanning games. Their preference for having routine and structure when functioning in the environment may be capitalized and positively viewed as a learning avenue. They may find it easier understanding words with a picture than purely auditory medium.

A person with autism, Grandin (2006), claimed that he thinks in pictures. According to him, both the spoken and written languages are like a colorful movie with complete sounds. When he talks to another person, the words are instantly translated to pictures. He is also aware that this phenomenon is hard to comprehend, epecially to language - based learners and thinkers. He finds his visual thinking skill an advantage because of his profession as an equipment designer in the industry of livestock.

As it has been pointed, the characteristics of students with autism can be viewed as a set of difficulties. They often have irregular patterns of cognitive strengths and weaknesses with the majority of them having some and degree of intellectual disability. Their unique features sometimes create significant challenges for those who serve them (Friend, 2011).Furthermore, they also face difficulty in understanding the emotional and social meaning that goes with the language to communicate and interact with the environment. They may also process differently the information they see, hear, smell and touch when compared to a typical individual (Dunn & Tomchek, 2007).

The present study was inspired to take the challenge of addressing and capitalizing on the unique learning characteristics of pupils with autism explained by the literatures in understanding autism .

Mathematics Skills

Teachers cultivate literacy in students by exploring multiple opportunities to help build competence in Mathematics. Teachers' knowledge of the math content provides facts and concepts to extend mathematical thinking.

According to Alontaga (2009), numeracy skills have been considered as a basic skill that an individual must acquire to be literate. Possessing it enables an individual to deal with the simple and complex life functions. Numeracy skills, just like reading skills, are essential to survive the scholastic challenges. The development of math skills follows a continuum where the prerequisite skill must be established first before an

individual can learn the higher concepts (Halpern, 2008). Math skills logically follow a continuum of interrelated skills. Any curriculum design for young children should be developmentally appropriate. The National Association for the Young Education, as cited by Smith (2009) enumerated two best practices in early childhood mathematics they are age appropriateness and individual appropriateness. The teacher must have a thorough knowledge of the physical, emotional and cognitive development of each age span. A six month old cannot run a foot race. Age appropriateness gives teachers these parameters. Every child has special interest, abilities and prior knowledge from home and culture. Individual appropriateness means that a good match is made between the learner and the curriculum.

According to Piaget as cited by Smith (2009), physical knowledge about color, size and shapes is used to construct logical mathematical knowledge. Logical mathematical knowledge is concerned with important relationship that creates the early foundation of mathematical thinking. Teachers study the mathematical relationship of matching, classification, comparing, ordering or certain to guide their students in an appropriate way.

He further said that number sense is using common sense in understanding the way the numbers and tools of measurement work within a given culture. It is a cognitive skill that is acquired informally. According to him, counting and number relationships develop slowly over the first seven years. Preschool children count in rote fashion. This ability has three prerequisite principles; stable order rule, the one to one rule

and the abstraction rule. The stable order rule means that the counting words used by adults are memorized in a certain order. Some children have one portion of the sequence stable, such as 1, 2, 3, and 4. The next part is repeated out of order on a consistent basis, such as 5, 7, and 6. Most children can count to 10 by the time they enter kindergarten. The one to one rule means that children say only one counting word for each object. Most teachers noticed that the accuracy of the count can is affected by the inefficient methods of keeping track of the counted objects of the counting sequence. When children master the standard sequence and keep of the total and the last number named, they arrived at the concept of cardinality, or matching a number to a set. Lastly, the abstraction rule means children understand that they can count dissimilar objects such as variety of farm animals (duck, chicken, and cow).

In support of the aforementioned concept, Libertus and Brannon (2009) described early numeracy as an ability to approximate that leads representation and manipulation of items without the need of number words. They pointed that developing number sense is an important element in a well-designed math program. In addition, number sense gives a deeper knowledge that is essential in learning the more complex and more advanced mathematical concepts. Poorly developed number sense may lead to difficulties in understanding and acquiring the ability to count, identify, name and write numbers. They further supported findings on children's math skills development of psychologists for many years.

Developing number sense is an essential foundation for success of mathematics in the early years. There are essential pre- number concepts child must acquire namely; sameness, matching, sorting, comparing, ordering, subtising (Boreman & Rucker, n.d.). The concept of sameness develops when the child identifies which objects are similar. The concept of matching leads to understanding the concept of one-to-one correspondence. Matching becomes a prerequisite skill for more complex skill of conservation. Sorting is the ability to see the other attributes of the objects and the ability to group them (e.g. sorting plastic balls by color). The concept of comparing focuses on the ability to compare items in terms of different concepts like tall and short, big and small smooth and rough etc. This will contribute to understanding concepts such as more or less. Ordering is the ability to position items in an order so that they can be counted. Ordering is a prerequisite to ordering numbers. Subitising refers to the ability to recognize a number of small groups of items without actual counting and seeing it as a single unit.

The Early Years Foundation laid a guide about what skills typical a child aged 2.5 to 5 years old should be capable grasp or talk about (British Association for Early Childhood Education, 2012).According to the aforementioned guide, children should identify, build and describe patterns of objects they explore and describe the characteristics of objects around them using the mathematical language they have learned. To give a clearer picture, Early Years Foundation (EYS) defined the skills of children aged 30-50 months. First, the child uses selected number names and number

language spontaneously in play. Second, the student recites 1 to 10 in sequence. Third, the child identifies quantity in a set and understands numbers with the use of fingers, marking or pictures. He could match numbers and quantity properly and expresses simple comments that show interest. The child also shows curiosity regarding numbers compares two groups of objects and tells whether they have the same quantity. The child also displays an interest in numbers in the environment and in number representation. For children aged 40-60 , they are expected to recognize the personal significance of certain numbers, numerals 1 to 5,count up four items by saying one number name for each item, count objects which are stationary, count objects up to 10,count objects beyond 10 and count out up to six objects from a larger group.

Comparing the pre-mathematics concept enumerated of Boreman and Rucker (n.d.) and basic math concepts of British Association for Early Childhood Education, It is worth noting that the skills are lifted in a pre -kindergarten perspective and that these skills are necessary as a pupil enters the kindergarten level up to the succeeding levels. In kindergarten, pre-mathematics skills refer to the math readiness competencies included in the kindergarten, K to 12 curriculum composed of number sense competencies. The development of math skills follows a continuum where the prerequisite skills are established first before an individual can learn the higher concepts (Halpern, 2008).

These defined skills affirmed that the pre-mathematics skills in the curriculum for kindergarten pupils autism should be developmentally appropriate, individually tailored and socio-culturally appropriate (Department of Education, 2012)..

Kindergarten refers to the initial entry level of a learner under the K to 12 curriculum. Learning in this level is done through play and interest and not through pure discussion. This bill cited that educators should base pupil's early experiences on play activities. With this, entering pupils with autism in kindergarten could be helpful in addressing their needs. Social interaction and other strategies can also be used.

According to Dizon and Sacris (2003), due to the nature of autism and the unique challenges associated with the diagnosis. Teachers are having difficulty assisting students with autism because they have unique needs that could be hindrances for the teachers. Recognizing this obstacle, the use of curriculum modification was recommended and implemented in the forms of adaptations and accommodations to foster optimum learning based on individual's needs and potentials.It shall include an array of service of delivery options (Department Order 72,s 2009). Department of Education recommends the use of approaches that explicitly address the needs, instructional levels, and interests of the students and the use their mother tongue as medium of instruction. Curriculum modification envisions functional literacy among students with autism through the use of thematic and integrative strategies with the addition of applied behavior approach to achieve the learning goals across various domains. Furthermore, there is a need to develop their attention and memory which impact their early educational experiences. This was still in line with the aim of modifying their behavior in a socially acceptable way. The present study was inspired to take the challenge of providing pupils with autism

a material that would address their learning behavior while learning the pre-mathematics skills of the curriculum.

Autism and Early Mathematics Concepts Strengths and Weaknesses

With their unique learning characteristics, autism leaners usually excel in mathematics because they can arrive at a definite answer when they grasp the logic of the procedure like in sequencing and matching .However, they may also struggle in mathematics because of the sophisticated verbal instructions accompanied with it and the sensory processing difficulties they possess which may affect how they grasp the information during instruction (Dunn & Tomchek, 2007). In addition, the Ontario Ministry of Education (2007) stressed that sophisticated verbal instruction and the complexity of mathematical terminologies can be very challenging because of the students with autism's language processing difficulties. Most of them may also have fine motor problems which result to difficulty doing math activities with pen and paper.

On the other hand, acquiring skills in matching, sorting and counting may be easy for individuals with autism due to their unique detail processing style (Tucker, n.d.). Seemingly, they reach only a memorization level and learning the mathematical concept. They should not stop rote memorization, but instead, strive to acquire a level of conceptual understanding.

Failure to acquire conceptual understanding of mathematical concepts may lead to errors in the future like spatial relationship, positional vocabulary, errors in number-word

orders , difficulty with one –one tagging, over counting, failure to understand that the last number in the a set content means its totality and errors in reading and writing numbers. In turn, students with autism who have a poor foundation of number sense and conceptual understanding may experience difficulty in counting, naming, remembering and writing numbers. (Schiller, n.d.) . The learning atmosphere also plays an important role in the struggle they faced in learning the concepts. Since parents and teachers have inadequate knowledge regarding the condition of autism, they tend to treat students with autism in a way that they disregard their strengths and just focus on the impairments they have. This often leads to undesirable attitudes such lack of motivation and feeling of failure on learning (Savoie, n.d.).

In the same vein, Sansosti et al. (2010) emphasized that focusing more on the strengths of students with autism can minimize the effects of their impairments. It is just a matter of appreciating more of what they are capable of doing rather than what they cannot do. For example, knowing that students with autism is more attuned to detail-focus processing style and routine , mastery may be attained easier if the concepts they are learning are presented in repetition. Sensory processing difficulties will have a lesser negative impact if stimulus presentation is structured (Happe & Frith, 2006).Furthermore, taking advantage of their good visual processing skills encourages utilizing visual support in instructional delivery (Lantz, 2002).

A successful instructional experience for students with autism is a matter of having a positive mindset towards them. Identifying things they are good at may increase

the success rate in math instruction. More so, following a developmentally appropriate practice, math continuum, understanding that students with autism have strengths and weaknesses and developing materials based on their characteristics are just some points to be emphasized. Thus, an important point was given in striving to develop instructional interventions and strategies that appropriately address their traits and characteristics as learners.

Using curriculum modification, students with autism could access the general education by simplifying the learning contents. In terms of pre-mathematics skills, the Department of Education prescribes that a student should be able to show understanding of basic mathematical concepts of size and length of the object, recite numbers in sequence, and copy numbers. Recognizing the unique characteristics of students with autism, adaptation in content and methodologies can be done, which result in a more individualized and inclusive learning environment.

Computer -Based Intervention and Courseware for Autism

Computers are gradually becoming part of the lives of young children. Since the world gets in more innovated technologies, integrating technology has been welcomed as an innovative practice not only in the general education but also in Special Education. For years, educators have been aware of the advantages of introducing students to an enriched learning environment that reinforce the students' primary learning style whether they are auditory kinesthetic or visual learners. Emiliani (2006) stressed that integrating

technology in the Special Education setting has been supported by lots of investigation as it yields to beneficial results. Teaching math skills together with the integration of technology has been documented effective in the field of Special Education.

Algrim-Delzell, Agnello, Jimenez and Knight (2009) affirmed that computer-aided instruction strategy is effective in teaching skills such as recognizing numbers and sorting and counting. In addition, Resanen, Salminen, Wilson, Aunio & Dehaene (2009) stressed the improvements in number comparison skills of students with low number skills in the kindergarten level when exposed to educational computer games. They claimed that students with autism are motivated by predictability and consistency .This is the reason computers are seamless assistive technology tools for learning. They put the student in the lead and facilitate learning and independent functioning. They further insisted that students with autism who use computers have increased attention span, can stay in their seats longer, improved fine motor skills and showed greater ability to generalize skills across environments. Computer use has been also instrumental in reducing excessive behaviors such as agitation, perseveration and self-stimulatory behaviors (Helfin & Alaimo, 2007). Due to the enormous benefits computer can provide, it should be an integral part of Special Education, not just only us as a reward or during playtime.

According to Silver and Oakes (2001), autism population responds well to computer aided instruction programs. These programs offer predictable and stable results and never suffer from fatigue, unlike caregivers who invest much of their time and

resources towards helping these students. Students with autism may pay more attention to computer programs than traditional learning environment. As a result, their learning potential can really increase with the use of these programs (Moore & Culvert, 2000).

Computer-based methods provide a very good way in educating students with autism. Researchers have documented positive gains of using computer- based interventions in teaching students with autism concepts and skills in identifying and predicting emotions, problem solving skills and reading skills. More so, it can be used in enhancing the overall learning of academic skills (Goldsmith & Leblanc, 2004)

Moore and Culvert (2000) commented on the efforts made to introduce computer assisted instruction as a means of relieving the burden of one –on-one instruction for students with autism while creating a more efficient medium for intensive instruction. They said that students with autism find computer based intervention more interesting and motivating than teacher-based instruction. Furthermore, students spend more time paying attention when they work with computers. The development of computer -aided instruction for students with autism could lead to breakthroughs in overcoming the social, communication and behavior difficulties associated with autism.

In addition to many established benefits of computers in instructional technology, Silver and Oakes (2001) pointed out that there are several additional reasons why computer intervention programs appropriate choice for students with autism. Students with autism faced sensory overload, they cannot filter out unneeded sensory inputs. Placing a student at a computer terminal can help avoid the problem because only

important information needs are displayed. The computer also provides an extremely stable environment. Furthermore, the computer has the ability to produce without fear of fatigue or boredom. The goals and expectations are transparent to the student and the program moves at his own pace, not one set by the instructor or other students in the class. This idea was supported by Tomorszki (2013) who elaborated that the predictable characteristic of the computer makes it less threatening for student with autism. The computer - based technology employs visual presentation which is fitted to students with autism visual learning skills. More advanced technology addressed address the motor difficulties of autism in manual dexterity in the form of touch screen function for navigational control.

Communication skills are not the only target of computer intervention programs. Bernard-Opitz,Sriram, and Nakhoda-Sapuan (2001) said that students with autism can be trained on problem-solving strategies with the help of computer interfaces. They also encouraged investigation to establish whether computer-assisted instruction will generalize to spontaneous problem situations in real life.

Silver and Oakes (2001) supported the use of computer -aided instruction in teaching about the emotions of others to students with autism. They further emphasized its positive effects in the social issues of students with autism. They also encouraged future assessment be done to determine whether these gains generalized into real life. In addition, Strickland, Marcus, Mesibov, and Hogan (1996) pointed out that virtual reality

platform as a computer intervention be explored .They proposed that it is a promising tool in improving social skills, cognition, and functioning in autism.

The emergence of educational software more commonly known as courseware is a tool for teachers and parents since technological innovations are inevitable nowadays. Courseware refers to an educational material kit for teachers or trainers for students, commonly parcelled for use with a computer (Veluz, 2015).Courseware can include the material for instructor-led classes, material for self-directed computer-based training (CBT), web sites that offer interactive tutorials, material that is coordinated with distance learning, such as live classes conducted over the Internet and also videos for use individually or as part of classes

However, though there is a need for a computer aided approach in the education for students with autism, certain concerns were noted. According to Chong & Putnam (2002) despite the availability of the said technology for students with autism, few have access to it due to the complex means just to operate and high purchase price. In addition, they further emphasized that most computer based technologies currently being used for students with autism limitedly reflected on their unique characteristics and these technologies was designed and intended for typical students.

The concerns stated previously were also the same in the Philippines. Most of the technologies, including courseware available in the market are intended for typical students who have the normal learning ability. Veluz (2015) also stressed why technology has an increasingly essential role in helping Filipinos with autism live purposeful lives.

Children at an early age today are much inclined to technology. In consonance with interest –based teaching, Department of Education encourages Special Education teachers to explore the use of new technologies to develop and enhance the overall skills of students with autism. The present study was inspired to take the challenge to address the insufficiency of local technology for pupils with autism.

In an educational context, the items on the Educational Software Evaluation Checklist by Back and Miller (2001) were usually used to evaluate the educational characteristics software courseware .The said checklist contained items that described what educational software should be. These criteria were; instructional content, layout, accessibility, age / grade level appropriateness, learner engagement/ interactivity assessment, technical quality and graphics /multimedia .Instructional Content refers to the educational content and capability of the courseware. Layout refers to the arrangement of texts, pictures and illustrations in a courseware. Accessibility refers to the courseware's characteristic to be user-friendly in terms of usability. Age / Grade Level Appropriateness refers to the suitability of the courseware to the ability of its intended user. Learner Engagement/ Interactivity refers to the level of communication or contact that the courseware provides with its user. Assessment refers to the ability of courseware to monitor progress by evaluating outcome or response from the user .Technical Aspects refers to the program workability in terms of the links and resources used as part of the courseware. And Graphics / Multimedia refer to the qualities that pictures, sounds graphics and animations generate to

optimize learning (Bach & Miller, 2001). These criteria were adapted and modified by the researcher to fit the current study's nature, scope and variables served.

Multimedia Approach for Autism

The use of multimedia such as sound effects, graphics and animation design to hold the attention and interest of students can make the instructional sessions more interesting and motivating. Mayer (2009) who defined multimedia as the simultaneous use pictures, words music, graphics etc. claimed that people learn better from words and pictures rather than from words or pictures alone.

Rosely (2007) pointed out that to deal with the limited attention span of students the level of interactivity of sounds, music, color and animation can be designed creatively. For example, using comic sounds and vivid colors may motivate the students to interact actively. Yet, careful planning should be considered so as not to overwhelm or over stimulate the student especially those with autism who have sensory processing difficulties. They may also be distracted if multimedia are to be used in an excessive manner.

Games are one of the usual methods that teachers used to enhance learning. According to Ang and Zaphiris (2005), the use of such approach supports students to construct learning based on experiences. They also mentioned that during ancient times board games were already used to stimulate and challenge the student's mind. In the course of playing the game, the reward that the player gets after playing attributes to its

motivating and entertaining characteristics. The emergence of computer games from unsophisticated, simple games possess the same nature and characteristics to teach, at the same time, entertain its user.

In a storyboard reflection, Gurney (2012) emphasized that the instructional experiences in using multimedia approach should follow a science of instruction. In other words, the methods used to create evidence based practices and principles to help people learn must be derived from the multimedia learning principles. She also asserted that the principles in multimedia learning are not universal .These are just given to guide in utilizing a multimedia approach. Still, the characteristics of the users are the primary guidelines in determining the principles to be adapted.In the context of students with autism. Gurney (2012) enumerated six principles possibly suited in their context. First is *segmentation* which tells the multimedia lessons should be presented following the learner's pace segment than continuous whole unit .This is because autism is a complex disorder, students with autism may require breaking down concepts into parts. By breaking concept onto different segment reduced the sensory and cognitive overload experienced by most them. Second is *personalization* which tells that learning is better when words used are presented in conversational style than a formal style. Because students with autism have difficulty in task engagement, this could help them be engaged. This provides a one on one atmosphere using conversational and informal language within the text and audio narration. Communicating with a friendly human voice and using polite expression creates a conversational tone. Third is the *coherence* which tells

that learning is better when necessary materials are only included. Text and graphics that are relevant materials were combined and aligned with the delivery of instructions. The visual support helps clear up complex concepts.Fourth is *modality* which tells that learning is better with the use of printed text and narration than graphics and printed text. In the absence of visuals to explain instruction, providing the printed text with audio narration is better for students with autism provided that there is control over audio. Fifth is *multimedia* which tells that words and pictures encourage more than words alone. Since students with autism lack motivation, plain text discussion may not be effective. Systematically presenting words, pictures, sounds and animation could motivate and encourage learners with autismto actively participate. And last is *voice* which tells that learning is better when the multimedia messages are delivered using a friendly human voice than a machine generated voice .Since students with autism have difficulty recognizing the mental states of others, using a friendly human voice to deliver the multimedia message can serve as a strategy to encourage critical thinking skills. These principles provided direction to support for students with autism. Following these principles would increase their motivation, attention and compliance to do multimedia related tasks since it accorded to their unique needs and learning styles.

Merging computer -aided instruction and multimedia approach to introduce, develop and enhance an educational concept, the researcher may produce a courseware. According to Rosely (2007) courseware can be defined as computer software that provides instructional material to learners. It is an educational material kit for teachers or

trainers for students, commonly parcelled for use with a computer. A courseware that incorporates multimedia elements can result to more beneficial outcomes by minimizing the difficulties in the learning process. He said that a multimedia courseware is a method which is conducted in a digital environment systematically designed with media elements such as sound effects, graphics and animation. In support of this idea, Adam and Tatnall, (2008) described that a multimedia courseware approach engages the learners' different senses.

Several foreign and local studies presented below were used as the researcher's guidelines in making his own study.

Descriptive Researches on Courseware Design Considerations for Autism

Specific user characteristics are very important to come up with a suitable material. The multimedia courseware could be designed by carefully considering the context of the pupils with autism. This holds true when dealing with them. Davis et.al (2007), in their study entitled "Creating software to promote understanding about narrative in children with autism" used six (6) students with autism to describe how each reacted to consequent feedback from the software. The analysis prompts reflected in the uniqueness of children with autism and the challenge to create supportive learning environments for them. The study enumerated design issues that are relevant when striving to develop a computer- based intervention for students with autism First, the design of the computer -based intervention should be dominated by visual representation

or visual support since students with autism are, in majority, visual learners and have good visual processing skills. More so, easily recognizable materials could be provided. Second, the interface design of the computer based program should be simple. Students with autism are more accustomed to detail focus processing of information which means they see details in chunk rather than the whole meaning. Making the interface simple would make it easier for students with autism to comprehend the information if necessary materials are only included. Third, design the computer program in such a way that the sounds and other multimedia elements should be capable of being adjusted. Students with autism have unusual response to sensory stimuli. They may perceive differently the same sensory inputs compared to typical students. The capability of the sounds and other multimedia elements to be adjusted could address the possible sensory overload that a student with autism may have while working with the computer. Fourth, design the computer program with easy to follow sequence of procedure. Button for the subsequent task must be provided. Students with autism love to have predictability in their environment that is why having a visual cue to signify the next procedure could be helpful. Fifth, the computer based program should be designed with simple navigation features. Students with autism usually have poor fine motor skills specifically hand dexterity. Design the computer based program in such a way that the movement or navigation from one stage to another, one area to another could address the manual dexterity issues of students with autism. Lastly, the computer program should be designed with the encouraging feedback. Since students with autism can easily be frustrated with

errors, including an encouraging feedback could lessen their anxiety when an error is committed. Furthermore, the reinforcement schedule could encourage the user to engage and continue with the game more because they have understood that by performing or finishing a task at a certain degree there will be a reward that follows. More so, selecting the most desired reinforcement can also influence the user's motivation to perform the task. In dealing with the aforementioned considerations for a multimedia courseware on pre-mathematics skills of students with autism, an instrument for evaluating the courseware design in connection to the user characteristics should be used.

In the same vein, Andal (2013) in his study entitled "Design considerations for developing an educational multimedia storytelling courseware for children with autism". Using three (3) preschool children with autism, he documented how each responded in a draft courseware .The results enumerated possible design considerations for a multimedia courseware that hoped to deal with learning characteristics and needs of children with autism First, the need for predictability and sameness is one of the concerns of developing a courseware for students with autism. This is why a developer should be careful in providing the level of control as well as the presentation of prompt so as to avoid the tendency to skip information. With this regard, using a balance of a nonlinear and linear plot will avoid the tendency to activate rote memory which may impact conceptual understanding of the concept being taught. Second, the varying sensory processing needs of children with autism lead to being hypo or hypersensitive to stimuli, thus, difference in the way of responding, providing control over the different

medium may address as it would be adjusted to fit their level. Third, it was also further emphasized that most children with autism possess problems with manual dexterity fatigue and weak grasp. Making the courseware capable of working on a touchscreen interface could address their difficulty because it could be easier to navigate in addition to the fact that most children with autism are acquainted with touchscreen gadgets like the iPad and android devices. The way children with autism use the courseware is impacted by the way they navigate the courseware. Fourth, children with autism could have the tendency to depend on prompts. With the said characteristics, using corrective feedbacks would be better than just warning sounds if an error is committed. Fifth, children with autism might get frustrated with technical errors while working on the courseware. Simple technical errors like not working links, delayed feedback would affect their motivation as they might be frustrated. Therefore, the developer should see to it that the courseware is free from technical errors. Another, most children with autism tend to focus on detail an account by the weak central coherence. With this, simple courseware design and transition would lessen overstimulation. Lastly, children with autism have difficulty recognizing whether their answer is right or wrong. This could be addressed by designing the courseware with easy to recognize visual like emoticon, an image of a facial expression to express the feelings or intended tone. This could address the issue as they can comprehend that a smile and sad face would mean to correct and incorrect answers respectively. The following above mentioned descriptive researches helped the researcher

identify possible design features that could be helpful developing the multimedia courseware.

Developmental Researches on Courseware Development

A foreign study by Muda (2006) entitled "Storytelling approach in multimedia courseware" focused on creating a courseware which introduced science concepts to typically developing preschool students who possess problem behaviors such as inattention and hyperactivity. The study recorded changes in the participant's behavior. The study found out that there was an increase in attention span of the participants during instructional sessions and that frequent standing during the lesson presentation of students were lessened.

Another foreign study conducted Hassan,Zahed, Zohora, Moosa,Salam, Rahman, Ferdous and Ahmed (2011) entitled "Developing the concept of money by interactive computer games for autistic children" presented a computer game based storytelling that helped students with autism understand money concept. The said game also helped teach appropriate social behavior while shopping. The results of the study revealed that a computer game form of delivery was good for students with autism as they become more motivated and engaged. The said study revealed that too much material displayed at once made the students confused sometimes as they become overwhelmed in processing the information. Recommending careful designing of computer based games.

The study by Hetzroni and Tannous (2004) entitled “Computer-based intervention program on the communicative functions of children with autism” created an interactive courseware *I Can Word It Too* that aided in improving the communicative functions among students with autism. The results showed that students produce sentences with less delayed and irrelevant speech and echolalia. It also showed increased communicative intent and functional communication skills, both expressive and receptive area of young students with autism that used it.

Ramdoss et.al, (2011) in their study “Use of computer-based interventions to teach communication skills to children with autism spectrum disorders” developed an educational courseware program called BALDI/TIMO to aid in teaching a particular skill to a student with autism. The said program has an individualization feature that could address the particular needs of its user. It also has an additional interface option where the teachers can freely design a lesson by uploading images. These studies emphasized that it is necessary to develop programs that are tailored-fit for autism users.

Another foreign study by Roslan (2012) developed a prototype courseware for children with moderate autism. The courseware Iqra' learning courseware and is aimed to help children understand the concept of number, acquire and apply the basic skills in mathematics in their life. The integration of two concepts, 'Drill and Practices' and Discrete Trial Training (DTT) are chosen models in its systems design.

One of the local initiatives was that of Darcen (2001) who conducted a study entitled “Development and validation of a reading courseware to develop the vocabulary

skills of students with autism". He made use of a descriptive and developmental research design which involved five phases. The result of her research showed that students with autism respond to new materials, but the instructional design should consider the learner's unique profile so that it will be more effective and appropriate for the target user.

Another local study by Andal (2014) entitled "Development and evaluation of an educational multimedia storytelling for children with autism" which was designed to assist teachers in introducing number sense to preschool children with autism. Using an instructional systems design, he crafted a storytelling courseware with contents from a foreign source and tested it to children with autism. The researcher also extracted possible design considerations for developing a multimedia technology specifically for children with autism. Considerations were given which are helpful in creating appropriate materials for these children. The findings were believed to be a good reference for future studies with the same nature.

The principles processes, methodologies employed in the studies mentioned above serve as the guide of the researcher to come up with a new study in line with the needs of the pupils with mentioned in the conceptual literature.

Synthesis

The related studies, ideas and concepts of different authors were considered to give substance to the content of this study. Concepts about developmentally appropriate

mathematical skills were given light by the ideas from Alontaga(2009), Halpern(2008), Smith(2009), Libertus and Brannon(2009), Boreman and Rucker (n.d), and Dizon and Sacris (2003)

Dizon and Sacris(2002) ,Mitchell and Rejendran(2007), Sansosti et al.(2010), Osteling and Dawson(1994), Landa(2000), Frith(2003), Plaisted(2001), McKenzie et al.(2010), Dun and Tomchek(2007), Chen et al. (2009), Attwood(2007), Rogers and Ozonoff (2005), Lane et al.(2010) and Helfin and Alaimo (2007) highlighted the characteristics and theories on autism.

Learning characteristics of students with autism were reviewed by Happe and Frith(2006), Luckevich(2008) ,Grandin(2006). Autism and Mathematics concepts were tackled by Tucker (n.d), Schiller (n.d), Savoie (n.d), Sansosti et al. (2010) and Lantz (2002). Their ideas gave the researcher different views on the best practices in teaching students with autism and their impact to student's performance.

Computer-based intervention autism was given emphasis by Algrim et al.(2009), Resanen et al.(2009), Helfin and Alaimo (2007), Silver and Oakes(2001), Moore and Culvert(2000), Tomorszki (2013), Bernard-Opitz (2001), Strickland et al.(1996), Chong & Putnam (2002) and Veluz(2015).

Multimedia, as an approach to hold the interest and attention of students with autism was discussed by Rosely(2007), Ang and Zaphiris(2005) and Gurney(2012). Davis et al. (2007), and Andal(2013) dwelt on tailored fit materials to be used in teaching students with autism and possible design consideration the meet their learning

needs. On the other hand, Bach & Miller (2001) dwell on the criteria for an educational software or courseware

The concepts and ideas of Muda (2006),Hansen (2014) Hassan et al.(2011) about the use of courseware in introducing learning concepts to students with autism were taken to provide essence to this study. Their thoughts about how teachers struggle with how to deal with students with autism were given due consideration. Information from Hetzroni, and Tannous (2004), Ramdoss et al. (2011) Roslan (2012) and Darcen (2001) were also given importance. Their ideas present the different programs that feature interactive courseware that aid in teaching particular skill to children with autism. Also of importance was the work of Andal (2014) which presented courseware design in storytelling and tested it to children with autism.

The mentioned studies provide a critical bridge between teaching and autism. Their studies were similar to the present study in the sense that they also determined the characteristics of students with autism. Yet, their studies were different because they focused on other curriculum while the present study concentrated kindergarten pre-mathematics skills. Evidently, there were some similarities in the mentioned studies to the present work, but this study's scope, purpose and variables served as its own unique features.

CHAPTER III

RESEARCH METHODS

This chapter presents the research methods utilized in the conduct of the study which include the research design, participants of the study, locale of the study, instruments used, data gathering procedure, data analysis as well as potential ethical considerations.

3.1 Research Design

The study made use of descriptive- developmental research design. The purpose of a descriptive developmental research is "to examine a sensation or condition that commenced at a specific place and time (Picciano, 2004). It was descriptive in nature because it made use of tools and approaches such as survey questions, rating scales, observation and interview in gathering and analyzing the information needed for the study. The researcher utilized a descriptive method in identifying the content of the multimedia courseware, the current level of kindergarten pupils with autism in terms of pre-mathematics and computer skills as well as in the design considerations for the multimedia courseware. Descriptive methods primarily aim to describe the nature and situation of a specific phenomenon as it commences at the time of the study and discover its causes.

The current study was considered to be developmental with its purpose since a multimedia courseware for kindergarten pupils with autism was developed, evaluated and tried- out. The study followed the developmental process. The descriptive research method was the best method to use to identify the content of the multimedia courseware, determine the design considerations for the multimedia courseware. In addition to this purpose, the researcher chose to employ a developmental research method to produce a suitable multimedia courseware on pre-mathematics skills for kindergarten pupils with autism. By this method, the researcher could contribute to address the early math difficulties of the pupils and necessity to address the insufficiency to provide ready – made supplementary material for Special Education teachers.

3.2 Participants of the Study

Ten (10) pupils with autism in the kindergarten level of Senator Claro M. Recto Memorial School Special Education Center participated in this study. All of them are male. With the help of the teacher – adviser, the participants were initially operationally identified as" high functioning" and "low functioning" level. Pupils on the high functioning level were pupils deemed to be more capable of using the multimedia courseware. They exhibit more manageable work behaviors and their mental functioning was on a level that may acquire a sense of comprehension through the developed multimedia courseware on pre-mathematics skills. The pupils on the high functioning level generally have characteristics like limited attention span, self-stimulatory behaviors

and even have limited language skills .Their behaviour problems could be managed into a level where they could still have self- regulation and respond to instruction with proper behavior intervention from the teacher.

On the other hand, pupils on the low functioning level were those whose priority program focused on self-awareness and daily living skills. With these distinctions, pupils on the high functioning level of the kindergarten fitted more as participants of the study. They were selected using the purposive sampling method because the study needed participants which fitted on the criteria and characteristics. The pupils who participated in this study are those pupils who have been diagnosed with autism, know how to use touchscreen gadgets and have been enrolled in the kindergarten class. The researcher further determined their math and computer skills with the use of PowerPoint version of the courseware, on a preliminary try –out .The youngest of them is age five (5) while the oldest is age ten 10.

Table 3.1 shows the summary of the profile of the pupils

Table 3.1
Profile of the Pupils

Participants	Sex	Age
1	M	5
2	M	5
3	M	6
4	M	7
5	M	7
6	M	8
7	M	8
8	M	8
9	M	10
10	M	10

The researcher asked the assistance of five (5) special education professionals; one (1) Education Program Supervisor in Special Education , three (3) school Special

Education coordinators and one (1) early intervention program manager for pupils with autism to validate the content of the PowerPoint version of the courseware Appendix B, p. 143).

The researcher also chose five (5) Special Education experts to accomplish the needs assessment. They also served as the evaluators on the content quality of the developed multimedia courseware. All of them have at least three (3) years of experience in teaching students with autism. They have knowledge on how to use a computer and touchscreen gadgets, have used computer -based programs in teaching students with autism and have attended the National Workshop on the Finalization and Revision of Special Education Modified Curriculum held in Tagaytay International Convention Center. Four (4) of them have Masteral units in Special Education while one of them has Master's Degree in Special Education and Doctorate units in Reading Education. There were two (2) Special Education teacher I and one Special Education teacher III from the public school. Two (2) were Special Education teachers from the private school (see Appendix C, p. 144).

The researcher also chose five (5) Information Technology (IT) experts. They were involved in assessing the technical quality of the multimedia courseware. Three (3) of them were from De La Salle University-Lipa and two (2) were from Systems Technology Institute (STI) College-Lipa. All are currently working as professors of multimedia and computer technology courses in their respective institutions. All of them are Masters in Information Technology (MIT) degree holder (see Appendix D, p. 145).

The researcher asked the help of five (5) experts to further validate the research instruments used in the study (see Appendix E p.146). All of them were from De La Salle University-Lipa .Two (2) are Special Education professors. Two (2) are Psychology professors. The other one is a college psychometrician. The four (4) college professors were also experienced teachers of students with autism both in educational and clinical set up. The pychometrician has experienced doing behavioral assessment for students with autism. The two (2) Psychology professors were also licensed pyschometricians. These experts validated the research instruments such as the *Power Point Version Content Validation Form, Preliminary Try out Observation Form , Courseware Evaluation Forms and Try –out Evaluation Form* using their judgment. The researcher thoroughly explained to the experts the nature, conceptual underpinnings of the study. Each of them gave their review. After that, all of them conferred to gain inter-rater reliability and validity. The researcher revised the items based on their recommendations for better organization of items.

3.3 Locale of the Study

The study focused on developing a multimedia courseware on pre-mathematics skills for kindergarten pupils with autism at Senator Claro M. Recto Memorial School Special Education Center, Division of Lipa City. The study was conducted during the fourth quarter of last school year 2014-2015 up to third quarter of school year 2015-2016. The school is a complete elementary school with 1600 students and 178 Special

Education students. The school's Special Education program envisions every child with special needs as independent as they can be self-reliant, productive and useful member of the family and of the society.

At present, it has an enrolment of thirteen (13) pupils with autism on the kindergarten level under the tutelage of a Special Education teacher. The study was conducted in the said school because it was considered the most established Special Education Center in the Division of Lipa City. Furthermore, being a public school, it is following the curriculum that the Department of Education prescribed.

3.4 Research Instruments

The quantitative part of this study was analyzed through descriptive statistics like weighted frequency , percentage and weighted mean in surveying the content of multimedia courseware on pre-mathematics skills and design considerations, benchmarking the current pre-mathematics skills , behavior and computer skills through preliminary try out , evaluating the content and technical quality of the multimedia courseware and the evaluating the results of the actual try out.

The *Needs Assessment Form* was consisted of two (2) parts. The first part used a four –point Likert scale designed to identify the learning competencies of pupils with autism (see Appendix F, p.147). The direction in the first part was to evoke the experiences the teacher had in teaching the stated competencies and describe the work that pupils with autism may require in learning the given competencies / concepts. The

first part is consisted of eight competencies culled lifted from the Kindergarten Curricular Framework for Pupils with Autism (2012). It was answered by putting a check under columns pertaining to the competencies rated as, 1 very difficult, 2 difficult, 3 easy, and 4 very easy. The weighted means are interpreted using the arbitrary scale: 1.0- 1.79 falls under very difficult, 1.80- 2.59 is difficult, 2.60 -3.39 is interpreted as easy and 3.40 – 4.00 for very easy. All the given competencies had been the content of the courseware because the researcher wanted to come up with complete curriculum based pre-mathematics skills multimedia material. The level of difficulty of each competency was used by the researcher to have an idea on how pupils with autism achieve on the curriculum based on Special Education teachers' experiences.

The second part of the needs assessment form used a four –point Likert scale designed to seek suggestions regarding the design consideration for the multimedia courseware on pre-mathematics skills for kindergarten pupils with autism The checklist was consisted of eight (8) items / criteria about the content and technical quality of a multimedia courseware but the items / criteria were stated in a suggestive manner instead of evaluative. The research instrument was validated by five (5) experts. The underpinning concepts and theories and its indicators were also explained to the experts for them to have a sound judgment in the improvement of the instrument. The main criteria for content are instructional content, layout, flexibility, accessibility, age / grade level appropriateness, learner engagement/ interactivity and assessment. For technical criteria, technical aspects and graphics / multimedia were observed. The eight (8) main

criteria have a total of twenty eight (28) sub criteria. A space was also provided for additional considerations or features.

The criteria given on the said checklist were rated as 4 very important; 3 moderately important; 2 least importance and 1 not at all important. The weighted means are interpreted using the arbitrary scale: 1.0- 1.79 falls under not important at all, 1.80-2.59 means least importance, 2.60 -3.39 is interpreted as moderately important and 3.40 – 4.00 for very important. The items which were rated as very important and moderately important were considered in the designing and development of the multimedia courseware. The needs assessment form is intended for the Special Education teachers with experiences handling pupils with autism who served as the content evaluators.

The *PowerPoint Version o*f the Courseware was constructed in response to the pre-mathematics content of the kindergarten curriculum for pupils with autism .The PowerPoint version was subjected to content validation by the five (5) Special Education professionals mentioned earlier. Its underpinnings and design implications were briefly discussed for them to have a sound judgment for improvement of the material. It was revised and finalized. The finalized PowerPoint version was divided into eight (8) parts with a total of 75 items distributed as follows; I(10),II(10),III(10),IV(10),V(10),VI(5),VII(10) and VIII(10) .The said material determined the current level and behavior of kindergarten pupils with autism in terms of pre-mathematics and computer skills during instruction. This functioned as the blueprint

that assisted the completion of the study .And was utilized by the teacher- adviser who facilitated the preliminary try out (see Appendix G, p.150)

The *PowerPoint Version Content Validation Form* was used to validate the content of the PowerPoint version of the intended courseware (see Appendix H p. 155). The checklist was consisted of eight (8) questions for curriculum content alignment. The items in the questionnaires were answerable by putting check on the *yes or no* column. A comment /suggestion box was provided after the *yes* or no column .Special Education professionals mentioned previously.

The *Preliminary Try out Observation Form* was used to aid in the observing the administration of the PowerPoint version. The first part is used to assess the each pupil's performance on pre-mathematics competencies. The second part was used to identify their behavior characteristics. It was consisted of seven (7) statements pertaining to characteristics of pupils with autism which were culled from the synthesis of characteristics based on previous studies on design consideration by Davis. et al (2007) and Andal (2013). A check mark was used to signify whether the characteristics were seen or not. There was also a comment section where the observation can be written. This instrument was utilized for matching the characteristics and designs to be included in developing the courseware (see Appendix I, p.156). This was utilized by the researcher as an unobtrusive observer in the preliminary try out.

A *Computer Literacy Checklist* was used to further determine the current level of computer skills of pupils with autism who participated in the study (see Appendix J,

p.157). It contains seven (7) statements that describe the computer literacy skills of pupils with autism .Based on observation, the ability of the pupil was rated on how he performs the following skills by writing a check (√) mark on the "yes no box". The degree of assistance needed may also be indicated from minimal, moderate to maximal. The checklist was adapted from Andal (2014) when he selected participants in his study in the development and evaluation of an educational multimedia storytelling courseware.

The *Multimedia Courseware Evaluation Forms* were used to evaluate content and technical aspects of the multimedia courseware on pre-mathematics skills (See appendix K p.158). These instruments contained the same criteria/statements on the second part of the needs assessment but stated in an evaluative manner. The content and technical quality evaluation forms were accomplished by the groups of Special Education teachers and IT experts mentioned earlier. It made used of a four- point Likert scale that evaluators answered by checking under the number that corresponded to their response to each criterion .The criteria on the said checklist were rated as 4 excellent ; 3 very satisfactory ; 2 satisfactory and 1 unsatisfactory . Likewise , the weighted means are interpreted with the same the arbitrary scale: 1.0- 1.79 unsatisfactory which means that courseware cannot considered as a supplementary material and need further polishing, 1.80- 2.59 satisfactory means that the courseware is considered as a supplementary material , 2.60 -3.39 is interpreted as very satisfactory means that the courseware is acceptable to be used as a supplementary material and 3.40 – 4.00 for excellent means that the courseware is highly acceptable to be used as a supplementary material.

The last instrument used in the study was the *Try out Evaluation Form* which was also a four-point Likert scale (see Appendix L, p. 161). It was designed to document, observe and check the experience and behavior of pupils with autism while using the multimedia courseware. The teacher -facilitator, occupational therapist and the researcher were instructed to put a check on the appropriate column. It is consisted of ten (10) items with a comment portion wherein the other behaviors that were observed are to be written. The items on the said instrument was rated as 4 strongly agree; 3 agree; 2 disagree and 1 strongly disagree. The weighted means are interpreted using the arbitrary scale: 1.0- 1.79 falls under strongly disagree, 1.80- 2.59 disagree, 2.60 -3.39 is interpreted as agree and 3.40 – 4.00 for strongly agree.

3.5 Data Gathering Procedures

An improved version of the ADDIE Model was employed in the development of the multimedia courseware on pre- mathematics skills. The ADDIE Model is a systematic process used in designing instructions and training programs. (Bahl, 2012). It followed a specific developmental stage. ADDIE stands for the five phases of the model, namely: Analyze Design, Develop, Implement, and Evaluate. Figure 3.1 presents the research process which consists of the stages in the conduct of the study. It also shows how the stages of the present research were modified to fit the specific purpose in multimedia courseware development.

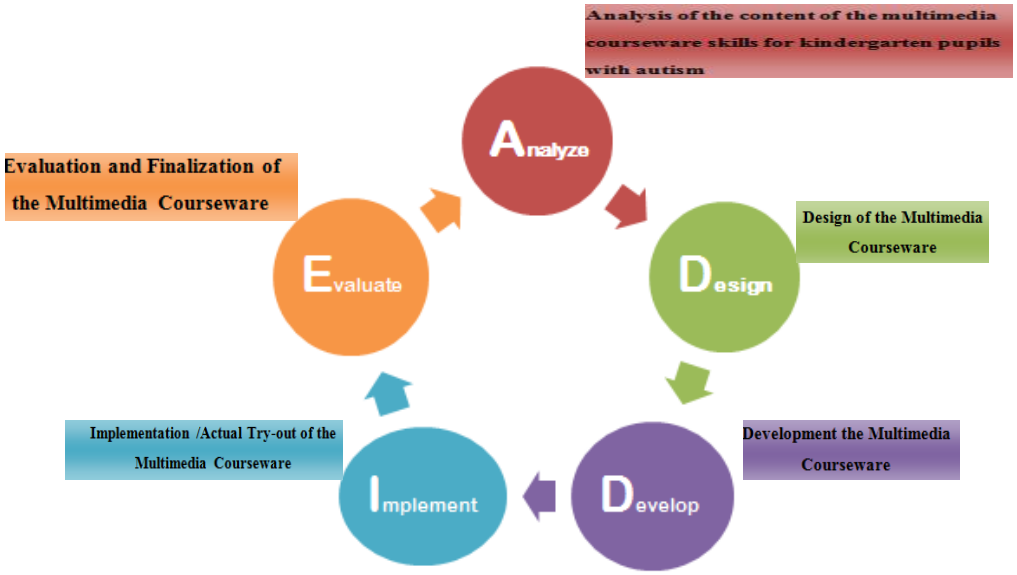


Figure 3.1. Research Process of the Study

(Source:https://kristinahollis.wordpress.com/tag/addie/)

Figure 3.1 presents the research process which consisted of the five (5) stages in the conduct of the study. The specific data gathering methods were discussed in each stage of the research.

Stage I- Analysis of the content of the multimedia courseware on pre – mathematics skills for kindergarten pupils with autism

Systematic procedure and coordination were done before the conduct of actual research process. The researcher forwarded request letters to the appropriate authorities and obtained approval before going on the research process (see Appendices M and N,

pp.162 and 163). The researcher obtained the approval of the division superintendent of Lipa City and school principal of the Senator Claro M. Recto Memorial School and was endorsed to conduct the study, including the administration of the different instruments to the students and teachers. Approval was also obtained from department heads and appropriate persons who will play their specific roles in the study (see Appendices O,P,Q, and R pp. 164-166)

This stage also encompassed laying the conceptual grounds of the study. The researcher also conceptualized the research purpose, searched, examined and reviewed the Department of Education policies, previous literatures and studies related to autism, math skills, design considerations, multimedia, computer- based intervention as well as courseware development. Findings from the gathered and examined literatures and studies were qualified and were taken into consideration in developing the purpose and foundation that would shape the framework of the study.

a. *Surveying on Pre-Mathematics Skills and Courseware Design Considerations*

In the analysis stage, teachers handling pupils with autism were asked to accomplish the needs assessment form. The first part of the needs assessment contained the competencies lifted from the Kindergarten Curricular Framework for Pupils with Autism (2012). All the pre-mathematics skills from first quarter to fourth quarter were copied from the curriculum with a total of eight (8) competencies. Table 3.2 shows the pre-mathematics skills covered in Kindergarten Curricular Framework for Pupils with Autism (2012).

Table 3.2
Pre-Mathematics Skills in Kindergarten Curricular Framework for Pupils with Autism

Pre-Mathematics Skills
1.Arranging objects in the order of size from smallest to largest
2.Selecting long, longer, longest from group of objects
3.Selecting short, shorter, shortest from group of objects
4.Locating first, middle and last in group of object
5. Locating front and back, left and right.
6. Naming coins: one, two, five, ten, twenty five, etc.
7. Constructing sets of one, two, and three up to ten objects, etc.
8.Counting orally from 1 to 10

The pre-mathematics learning competencies stated were evaluated by the Special Education teachers. This part was designed to identify and describe the work they require learning the concept. The level of difficulty of each competency was used by the researcher to have an idea on how pupils with autism achieve on the curriculum. All the given competencies were included as the content of the multimedia courseware because the researcher wanted to come up with complete curriculum- based pre-mathematics skills supplementary material.

The second part of the needs assessment was intended to seek recommendations about the design the multimedia courseware. The same group of Special Education teachers accomplished this section. The data obtained from the evaluators were tallied, tabulated and analyzed. The average mean of each criterion was computed. Those criteria with a mean rating of 2.60 and above were considered in the design and development of the multimedia courseware. These were described as moderately important and very important. Aside from the design considerations gathered, the researcher also look into

the written comments of experts on this section. The quantitative data collected here helped the researcher decide on the content and technical features to prioritize to have a suitable multimedia courseware for pupils with autism.

Furthermore, the researcher also made use of the results gathered from the needs assessment and opted to utilize a PowerPoint version of the courseware. This functioned as the blueprint that assisted in the completion of the study. The PowerPoint version was also checked by a grammar and language expert for language suitability. Some of the design features already reflect the principles and theories, to come up with asset, arrangement and presentation of the courseware though its initial multimedia features were limited only to the technical skills of the researcher. The content of the Power Point version was subjected to content validation by Special Education professionals (program supervisor in Special Education, school Special Education coordinators and a program manager for pupils with autism) for its curriculum alignment.

b. *Determining Current Level of Kindergarten Pupils Autism in terms of Pre – Mathematics and Computer Skills (Preliminary Try out)*

Using the validated Power Point version, the researcher determined the specific characteristics of kindergarten pupils, current pre- mathematics and computer skills of pupils with autism in a preliminary try out. With the help from the teacher- adviser, it was administered to the group of pupils deemed capable of using the material. The preliminary try out and was observed by the researcher. To aid in data gathering at this stage, the preliminary observation form and computer literacy checklist were utilized.

This was for matching the characteristics and design analysis that would be included further in to complete the design features of the multimedia courseware. This was done to have a triangulation of data for the intended design.

Stage II – Design of the multimedia courseware

a. Designing the Multimedia Courseware based on Results of the Analysis Stage

The researcher made use of the results gathered from the literature review, needs assessment and preliminary try out. The researcher completed the design details of the PowerPoint version. Resources like the Learning Resource Management and Development System (LRMDS), existing computer games and learning packages for students with autism were visited and examined to get additional ideas on conceptualization on the design features of the Power Point version. All the data gathered from the tasks done from the previous stage were carefully considered.

b. Completing the Details of the Multimedia Courseware Design Features

After gathering all the necessary data, the researcher asked the assistance of a professional multimedia artist as the illustrator for the refinement of the design.The appropriate multimedia elements and features like the home screen background color, activities, picture, animation, transition, type of response, music, sound, instructional program flow, level of multimedia interaction as well minimum system requirements to make the courseware work were detailed furthered

Stage III – Development the multimedia courseware

a. Developing the First Model of the Multimedia Courseware (Multimedia Development Process)

The researcher sought the assistance of a computer programmer who coded the specified design features into a computer program. The researcher also interviewed the computer programmer to have an idea on the multimedia development process.

According the computer programmer, the following steps were undertaken : (1) *reviewing of project scope and limitation* where project timeline was determined; (2) *setting up tools for development* where the application program and asset development engine were selected (*Unity* Integrated Development Environment (IDE) and Adobe Photoshop); (3) *preparing virtual table of contents* where the program flow chart was determined; (4)*gathering necessary assets, which pertain to resources* like graphics , sounds, contents, scripts were selected; (5) *coding*, the act of converting statements in a particular programming language was done; (6) *producing the project* where the coded program was put up in a specified operating system and (7) *revising the project based on end -user feedback* where adjustments were made for quality assurance of the intended first model .

A contract was made for the said project. Constant communication was done to make sure that the courseware followed the specified design included. The cognitive multimedia principles appropriate for autism users were applied. The multimedia courseware was design with a balance of linear and nonlinear play, a tap and drag

function. The said linear play minimized the tendency to stimulate rote memory by not allowing the user proceed without getting the correct response first. The nonlinear play allowed the user freedom to play what section he wants. Motive questions, simple instructions, corrective and encouraging feedbacks were also provided. The touch screen function dealt with their perceived manual dexterity problems, thus making the multimedia courseware motivating and simple.

b. Reviewing and Validating the First Model based on Experts' Judgement

The researcher examined the developed multimedia courseware for quality assurance. The researcher then identified ten (10) experts to evaluate the workability of the courseware. Five (5) experts in the field of Special Education were sought to evaluate the content quality and the suitability of the multimedia courseware as a supplementary material for pupils with autism. On the other hand, the other five (5) experts in the field Information Technology evaluated the technical workability of the multimedia courseware.

Then, the researcher looked into the most convenient time of each evaluator to personally hand the device with installed multimedia courseware. Each evaluator willingly gave their time to evaluate the courseware. Their comments and suggestions were written on the evaluation sheet. Each of them also explained their suggestions and clarified some features in the courseware that needed revision.

The courseware was evaluated using the 4-point Likert Scale where 4 excellent; 3 very satisfactory; 2 satisfactory and 1 unsatisfactory. Likewise, the weighted means are

interpreted with the same the arbitrary scale: 1.0- 1.79 unsatisfactory, 1.80- 2.59 satisfactory, 2.60 -3.39 and 3.40 – 4.00 for excellent.The courseware evaluation forms were retrieved from the experts. Their suggestions were collected and interpreted. Then, revisions were applied based on the experts' evaluation and recommendation. Their suggestions were used to improve the multimedia courseware.

Stage IV – Implementation /Actual Try out of the multimedia courseware

Then, the researcher conducted the try-out of the multimedia courseware to ten (10) purposely selected pupils in the kindergarten level. The needed device was also prepared. The researcher arranged the availability of the participants. The room was set up. Before the actual try -out, the researcher requested the assistance of an occupational therapist to conduct an independent observation. He has expertise in individualized behavioral assessment, management and instruction for students with autism and other disabilities like Attention Deficit Hyperactivity Disorder (ADHD) and Learning Disability (LD). He was also given sufficient briefing regarding the study. Before calling the scheduled pupil, the teacher- adviser had a quick re –examination of the material. Proper pupil orientation was given. During the actual try out, the researcher and occupational therapist used the try out evaluation form to conduct independent observations. It was noted that the teacher- adviser provided prompts only when necessary. When the participant finished using the courseware, a break of 10-15 minutes was given to provide time for the teacher- facilitator to accomplish the try out evaluation

form. One participant was scheduled each day and was given a maximum of one hour to play.

The same procedure was done the following days until all the participants were done using the courseware. The results from the try out evaluation form were tabulated, treated and interpreted.

Stage V- Evaluation and Finalization of the Courseware

After conducting the actual try out, the researcher has considered the suggestions from the occupational therapist and teacher-facilitator to revise and finalize the multimedia courseware. The weighted means are interpreted using the arbitrary scale: 1.0- 1.79 strongly disagree, 1.80- 2.59 disagree, 2.60 -3.39 agree and 3.40 – 4.00 for strongly agree.

3.6 Data Analysis

The raw scores from the research instrument of the identification of learning competencies, design considerations, preliminary try out, evaluation of the courseware and actual try -out were tabulated to have a summary of the response from the evaluators. Weighted frequencies were computed by multiplying the frequencies of the responses by their corresponding point-scale value.

Then, the weighted mean was computed by dividing the summation of the weighted frequency by the sum of the frequencies.

$$WM = \frac{\Sigma f \cdot scale\ value}{N}$$

where:

WM = weighted mean **Σ =** sum

f = frequency N = total number of evaluators

Narrative summary was also used to give further description and summary of the of each pupils' performance.

3.7 Potential Ethical Considerations

In observance of the proper research ethics, the following actions were taken:

1. Systematic procedure and coordination were done before the conduct of research. Formal request letters were forwarded to appropriate authorities and obtained approval before going on the research process.

2. The researcher gave tokens to the participants and was assured the confidentiality of their identities.

3. Professionals such as the Special Education teachers, Information Technology experts and instrument validators who participated in this study were given sufficient

time for them to accomplish the forms at their most convenient time.

4. Letter of permission was obtained from the authors whose instruments were adapted and modified. Due recognition and acknowledgement was also given to them.

5. The researcher made sure that the multimedia artist, voice talent and computer program were given proper compensation for their contributions in the design and development of the courseware.

6. Parental consent was obtained since the pupils with autism lack the capacity of conveying their willingness to take part in the study (see Appendix S p.167). Photo and video consent were also obtained. The researcher also respected the parents' decision regarding the extent to which the information was utilized.

7. The try out /implementation time was scheduled in the same class program schedule of the pupil. This was to prevent the possible inconvenience of parents, the teacher- facilitator and the pupils

8. The researcher relied to parents what had transpired during the preliminary administration and actual try - out.

9. Breaks were provided to the pupils when showing signs of tiredness.

CHAPTER IV

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter presents the discussion, analysis and interpretation of data which follow the sequential order of the purpose of the study in Chapter 1 as well as all the procedures done relevant to the development of the study.

4.1 Identify the content of the multimedia courseware on pre – mathematics skills for pupils with autism

The researcher had conducted a two part needs assessment wherein the first part evoked experiences from the Special Education teachers handling pupils with autism. "Arranging objects in the order of size from smallest to largest," "Selecting long, longer, longest from group of objects," "Selecting short, shorter, shortest from group of objects," "Locating first, middle and last in group of objects," "Locating front and back, left and right," "Identifying coins: one, five, ten, twenty five, etc.," "Constructing sets of one, two, and three up to ten objects" and "Counting orally from 1 to 10" were eight competencies under the pre-mathematics area. The identification of the learning competencies part was answered by five (5) experienced teachers of pupils with autism in early intervention and kindergarten level. They identified and described the prerequisite skills needed to possess to learn the pre-mathematics competencies stated.

Table 4.1 on page 76 presents the results of the pre-mathematics learning

competencies level of difficulty perceived by the Special Education experts for pupils with autism. They were given sufficient time to recall and assess the level of difficulty of pupils according to their experiences. In doing so, they could give precise answers to the needs assessment.

The table shows that the learning competency "Arranging objects in the order of size from smallest to largest" gained a mean of 3.00 and was rated easy. This implied that all of them perceived arranging objects in the order of size from smallest to largest as one of the pre-mathematics skills that pupils with autism find easy to learn. The researcher, being a teacher of pupils with autism could also attest the perception of the Special Education experts about arranging objects in the order of size from smallest to largest being an easy task.

The competency "Counting orally from 1 to 10" got a mean score of 3.20 and was perceived very easy by two Special Education experts while another two rated it as easy and one of them rated it as difficult . Despite the differences in their perceptions, the competency of counting orally from 1 to 10 had an easy description. One possible reason for the competency's easiness may be attributed to the rote nature in counting orally one (1) to 10.

"Arranging objects in the order of size from smallest to largest" and "Counting from 1 to 10 orally" with mean score of 3.00 and 3.20 respectively were perceived by Special Education experts as pre-mathematics concepts that pupils with autism find it easy learning. This could be attributed to their ability to better respond visually. Being visual

learners, they are characterized with good visual processing skills and detail focused processing skills (Happe & Frith, 2006; Tucker, n.d). Acquiring skills in matching, sorting and counting may be easy for pupils with autism due to their detail processing style.They can grasp these tasks simply with the use of visual observation and scanning. Likewise, acquiring rote counting skills may be easy for pupils with autism because the number system is sequenced and structured which suited to the way most of them learn and remember.

On the other hand, the competency "Selecting short, shorter, shortest from group of objects" gained a mean of 2.20. Four (4) of the five Special Education experts rated it difficult while one rated it as easy.

The competency "Locating first, middle and last in group of object" also gained a mean of 2.20. Four (4) of the five Special Education experts rated it difficult while one rated it as easy which is still described as difficult.

The competency "Locating front and back, left and right" also gained a mean of 2.20 of which four (4) of the five Special Education experts rated it difficult while one rated it as easy which is still interpreted as difficult.

The competency "Identifying coins, one, five, ten, twenty five, etc." obtained a mean of 2.40. Two (2) of five Special Education experts rated the competency easy while three (3) experts rated it as difficult. Yet, it was still described as difficult.

The last competency "Constructing sets of one, two, and three up to ten objects, etc." also obtained a mean of 2.40. Two (2) of five Special Education experts rated the

competency easy while three (3) experts rated it as difficult Nonetheless, the said competency still falls under the difficult description.

The six learning competencies "Selecting long, longer, longest from group of objects," "Selecting short, shorter, shortest from group of objects," "Locating front and back, left and right," "Locating first, middle and last in group of object," "Identifying coins, one, two, five, ten, twenty five" and "Constructing sets of one, two, three, four and five objects, etc." with mean score of 2.20.,2.20.,2.20, 2.40 and 2.40 respectively were perceived by Special Education experts as pre-mathematics concepts that pupils with autism may encounter difficulty learning. The reason for this may be attributed to what Dunn and Tomchek (2007) said that pupils with autism struggle in mathematics because of the sophisticated verbal instructions accompanied with it and the sensory processing difficulties they possess. This also coincides with the assumption of Sensory Processing Difficulties Theory. Additionally, Ontario Ministry of Education (2007) stressed that sophisticated verbal instruction and the complexity of mathematical terminologies can be very challenging because of the pupils with autism's language processing difficulties. These competencies require understanding the relationships in order to be understood and learned. As shared by the experts and also from the experiences of the researcher himself, pupils with autism may also face difficulty in grasping the aforementioned concepts due to the vocabulary issues. In addition, these competencies involved seeing the whole picture instead of segmented details. Since individuals with autism are more focused to detail processing, they may face the difficulty of conceptually understanding these

concepts as explained by Weak Central Coherence Theory. The quantitative data collected from the first part of the needs assessment helped strengthen the purpose of coming up with a complete multimedia courseware .This implied that much of the pre-mathematics skills should still be work on among pupils with autism on the kindergarten level since six (6) of the eight pre- mathematics learning competencies were perceived difficult by Special Education experts. On the other hand, the researcher strived to improve the two (2) learning competencies deemed easy for them through the use of multimedia technology in its presentation.

Table 4.1

Pre-Mathematics Learning Competencies Level of Difficulty

Learning Competencies	**Evaluators**					**WM**	**INT**
	1	**2**	**3**	**4**	**5**		
1. Arranging objects in the order of size from smallest to largest	3	3	3	3	3	3.00	**Easy**
2. Selecting long, longer, longest from group of Objects	2	2	3	2	2	2.20	**Difficult**
3. Selecting short, shorter, shortest from group of Objects	2	2	3	2	2	2.20	**Difficult**
4. Locating first, middle and last in group of Object	2	2	2	2	3	2.20	**Difficult**
5. Locating front and back, left and right.	2	2	2	2	3	2.20	**Difficult**
6. Identifying coins: one, five, ten, twenty five, etc.	3	2	2	3	2	2.40	**Difficult**
7. Constructing sets of one, two, and three up to ten objects, etc.	3	3	2	2	2	2.40	**Difficult**
8. Counting orally from 1 to 10	4	4	3	2	3	3.20	**Easy**

4.2 Design the multimedia courseware based on review of design considerations from previous studies and suggestions from experts

In response to the second purpose of the study, the researcher had examined literatures and studies that would help design the multimedia courseware. The descriptive studies by Davis et al., (2007) and Andal (2013) guided the researcher in enumerating the possible design considerations for the courseware .Table 4.2 presents a summary of design considerations from previous studies.

Table 4.2

Summary of Design Considerations from Previous Studies

Characteristics of Children with Autism	**Design issues relevant a computer- based intervention for autism** (Davis et al., 2007)	**Design consideration for courseware development** (Andal , 2013)
1. Need for sameness and predictability	➢ Use easy to follow sequence of procedure (Davis et al., 2007) ➢ Provide next bottom to signal for subsequent task	➢ Careful presentation of things on the courseware ➢ Level of control should be considered ➢ Using linear and nonlinear plot and with consistent and simple response
2. Varying sensory processing needs	➢ Sounds can be adjusted	➢ Use of different mediums sounds, pictures, text, animations and voice over instructions ➢ Provide control options for different mediums
3. Problems with manual dexterity fatigue and weak grasp	➢ movement or navigation from one stage to another, one area to another	➢ Touch screen features
4. Prompt dependent	➢ Use encouraging feedback	➢ Use corrective feedback
5. Frustrated with technical errors while working on the courseware	➢ Use encouraging feedback	➢ Free from technical errors
6. Focused on detail and good visual processing	➢ Dominated by visual representation or visual support ➢ Simple	➢ Simple interface design and transition ➢ Visual presentation
7. Difficulty to recognize right and wrong	➢ Encouraging feedback could lessen their anxiety when an error is committed	➢ Use easy to recognize visual like emoticons

The table shows the characteristics of children with autism namely; the need for sameness and predictability, sensory processing needs, problems with manual dexterity fatigue, weak grasp, prompt dependence, frustration with technical errors, detail –focus and good visual processing and difficulty of recognizing right and wrong should be considered . Davis et.al (2007) enumerated design issues that are relevant when striving to develop a computer- based intervention for autism. First, design the computer program with easy to follow sequence of procedure. Button for the subsequent task must be provided for students with autism love to have predictability in their environment that is why having a visual cue to signify the next procedure could be helpful. Second, the sounds and other multimedia elements should be capable of being adjusted. Students with autism have unusual response to sensory stimuli. They may perceive differently the same sensory inputs compared to typical students. The capability of the sounds and other multimedia elements to be adjusted could address the possible sensory overload that a student with autism may have while working with the computer. Third, it should be designed with simple navigation features. Students with autism usually have poor fine motor skills specifically hand dexterity. Design the computer based program in such a way that the movement or navigation from one stage to another, one area to another could address the manual dexterity issues of students with autism. Fourth, the computer program should be designed with the encouraging feedback. Since students with autism can easily be frustrated with errors, including an encouraging feedback could lessen their anxiety when error is committed. Furthermore, the reinforcement schedule could encourage them to

engage and continue with the game more because they have understanding that by performing or finishing a task at a certain degree there will be a reward that follows. More so, selecting the most desired reinforcement can also influence their motivation to perform the task. Last is the design of the computer -based intervention should be dominated by visual representation or visual support since students with autism are, in majority, visual learners and have good visual processing skills. More so, easily recognizable materials could be provided. Second, the interface design should be simple. Students with autism are more accustomed to detail focus processing of information which means they see details in chunk rather than the whole meaning. Making the interface simple would make it easier for students with autism to comprehend the information if necessary materials are only included.

In addition, Andal (2013) cited possible design considerations for a multimedia courseware that hoped to deal with aforementioned learning characteristics and needs of children with autism First, the need for predictability and sameness is one of the concerns in developing a courseware for students with autism. This is why a developer should be careful in providing the level of control as well as the presentation of prompt so as to avoid the tendency to skip information. With this regard, using a balance of a nonlinear and linear plot will avoid the tendency to activate rote memory which may impact conceptual understanding of the concept being taught. Second, the varying sensory processing needs of children with autism lead to being hypo or hypersensitive to stimuli, thus, a difference in the way of responding. Providing control over the different medium

may address as it would be adjusted to fit their level. Third, it was also further emphasized that most children with autism possess problems with manual dexterity fatigue and weak grasp. Making the courseware capable of working on a touchscreen interface could address their difficulty because it could be easier to navigate in addition to the fact that most children with autism are acquainted with touchscreen gadgets like the iPad and android devices. The way children with autism use the courseware is impacted by the way they navigate the courseware. Fourth, children with autism could have the tendency to depend on prompts. With the said characteristics, using corrective feedbacks would be better than just warning sounds if an error is committed. Fifth, children with autism might get frustrated with technical errors while working on the courseware. Simple technical errors like not working links, delayed feedback would affect their motivation as they might be frustrated. Therefore, the developer should see to it that the courseware is free from technical errors. Sixth is that most children with autism tend to focus on details an account by the Weak Central Coherence. With this, simple courseware design and transition would lessen overstimulation. Seventh and last is that children with autism have difficulty recognizing whether their answer is right or wrong. This could be addressed by designing the courseware with easy to recognize visual like emoticon, an image of a facial expression to express the feelings or intended tone. This could address the issue as they can comprehend that a smile and sad face would mean to correct and incorrect answers respectively. Being visual learners, they benefit on visual support than purely auditory mode of instruction. Review of related studies on design consideration

implied that the aforementioned characteristics pupils should be considered in the design of the courseware.

Aside from the review of related literatures and studies, the researcher used the data from the second part of the needs assessment to gather suggestions from the special education experts regarding the design considerations for multimedia courseware on the pre-mathematics skills .Table 4.3 presents the results of design consideration of multimedia courseware on pre- mathematics skills for kindergarten pupils with autism from experts

Table 4.3

Results of Design Considerations of a Multimedia Courseware on Pre- Mathematics Skills for Kindergarten Pupils with Autism from Experts

Criteria	Evaluator					WM	INT
	1	2	3	4	5		
Instructional Content							
1. Contents should be accurate, complete and current *(Coherence Principle)*.	4	4	4	4	4	4.00	Very Important
2. All the courseware contents should be related to the stated purpose/objective.	4	4	4	4	4	4.00	Very Important
3. Instructional content delivery should be suited for pupils with autism.	4	4	4	4	4	4.00	Very Important
					Mean	4.00	Very Important
Layout							
4. Layout should make it easy for the pupils to process graphics and text. *(Sensory Processing Disorders Theory)*	4	4	4	4	4	4.00	Very Important
5. Layout should be consistent in all parts (Coherence Principle).	4	4	3	4	4	3.80	Very Important
6. Layout should be clear. *(Sensory Processing Disorders Theory)*	4	4	4	4	4	4.00	Very Important
7. Layout should be logical *(Coherence Principle)*.	4	4	3	4	4	3.80	Very Important
8. Titles and subtitles should be clearly defined *(Sensory Processing Disorders Theory)*.	4	4	4	4	4	4.00	Very Important
					Mean	3.92	Very Important
Accessibility							
9. The courseware should accommodate the unique learning style of pupils with autism *(Weak Central Coherence Theory)*	4	4	4	4	4	4.00	Very Important
10. The courseware should be used by the pupils without much help from the teacher.	4	3	3	4	3	3.40	Very Important
11. The courseware should be accessible in any type of computer.	3	2	2	3	3	2.60	Least Importance
					Mean	3.33	Moderately Important
Age / Grade Level Appropriateness							
12. Reading level should be appropriate for pupils with autism.	4	4	4	4	4	4.00	Very Important
13. Product should be suitable for the age and grade level of pupils with autism.	4	4	4	4	4	4.00	Very Important
14. Directions are clear and complete enough for students to perform required tasks *(Segmentation Principle)*.	4	4	4	4	4	4.00	Very Important
					Mean	4.00	Very Important
Learner Engagement/ Interactivity							
15. The courseware should require pupils to become engaged and motivated.	4	4	4	4	4	4.00	Very Important
16. The courseware should employ multimedia enhancements principles to make learning interactive *(Multimedia Principle)*.	3	3	4	4	4	3.60	Very Important
17. Appropriate and encouraging feedback should be provided throughout the instruction *(Voice and Personalization Principle)*.	4	4	4	4	4	4.00	Very Important
18. Feedback should enable pupils with autism to recognize error commission *(Impaired Theory of Mind Theory)* .	4	4	4	4	4	4.00	Very Important
					Mean	3.90	Very Important
Assessment	1	2	3	4	5		
19. Assessment procedures should be appropriate and suited.	4	4	4	4	4	4.00	Very Important
20. Teachers should easily assess pupils ' progress by evaluating the outcomes provided within the product	3	4	4	3	3	3.40	Very Important
					Mean	3.70	Very Important
Technical Aspect	1	2	3	4	5		
21. All links should be working properly.	4	3	4	4	4	3.80	Very Important
22. The sounds should be aligned to the lessons / activities.	4	4	4	4	4	4.00	Very Important
23. The use of images should be aligned to the lessons / activities.	4	4	3	4	4	3.80	Very Important
24. All multimedia assets should work at all times.	4	4	3	4	4	3.80	Very Important
					Mean	3.85	Very Important
Graphics/ Multimedia							
25. Background and text should be pleasing, compatible and easy to read.	4	4	4	4	4	4.00	Very Important
26. Graphics should be appropriately designed to optimize learning of pre-mathematics skills *(Multimedia Principle)*.	4	4	4	4	4	4.00	Very Important
27. Graphics and animations should catch the interest of pupils with autism.	4	4	4	4	4	4.00	Very Important
28. Multimedia elements should be capable of being adjusted.	4	4	4	4	4	4.00	Very Important
					Mean	4.00	Very Important

The first criterion under content quality was “Instructional Content”. With a mean score of 4.00, all five (5) Special Education experts described instructional content as very important. The courseware developer should see to it that the contents are accurate, complete and current. All the courseware contents are related to the stated purpose/objective and the instructional content delivery is suited for pupils with autism. Relating it to what Davis et al. (2007) said that a computer- based intervention for students with autism should be dominated by visual representation because they are visual learners and have good visual processing skills. The interface design was simple because they have detail -focus processing of information. This idea was supported by the coherence principle (Gurney 2012). It is very important that the courseware holds the characteristics of an educational courseware in the context of pupils with autism. It should make use of visual information but it should have features for readers who have a preference on auditory medium. The courseware should be simple yet stimulating enough to address the different motivational levels of pupils with autism. It should have clearly stated goals and directions to deal with their need for a predictability and structure.

The data from the instructional content criterion fuelled inclusion of updated and timely materials and assets in designing and developing the courseware. It was made sure that directions were stated in simple and precise terms. The researcher also made sure that all contents were aligned with the objectives by anchoring the activities to the prescribed

curriculum competencies. The researcher also opted to let the Special Education professionals validate the content of the PowerPoint version to assure its validity and alignment with the curriculum. The researcher strived to suit the instructional delivery by carefully considering the behavior and characteristics of pupils with autism.

The second criterion under content quality was "Layout". With a mean score of 3.92, all five (5) Special Education experts described layout as very important .The layout of a multimedia courseware for pupils with autism should make it easy for the them to process graphics and text .Layout is consistent in all parts, clear, logical and easily defined . All of these should be considered because pupils with autism may have sensory processing difficulties that result to under or over reaction to stimuli (Dun & Tomchek, 2007). Adapting the coherence principle, the organization of assets and materials should be carefully planned since pupils with autism rely more on visual presentation (Gurney 2012). All the materials included in the courseware have importance. With the data gathered data in the layout criteria, the courseware's design was guided by simplicity. With this, only the assets that have significance were included such as basic icons and controls for navigation and multimedia features.

The third criterion under content quality was "Accessibility". With a mean score of 3.53, all five (5) Special Education experts described accessibility as very important. An accessible multimedia courseware for pupils with autism should accommodate their unique learning style. It could be used by them without much help from the teacher. It should moderately consider making it accessible to other types of computer.

Understanding the characteristics and the theories underlying the difficulties and behaviors of pupils with autism is essential in designing and developing effective strategy (Helfin & Alaimo, 2007). Furthermore, computer -aided instructions for them should consider the suitability of the instructional materials to address their unique characteristics (Davis et al., 2007). Running in all types of computer could be given lesser consideration because doing so could entail much work on the part of the developer. Nevertheless, making it accessible and useful with affordable platforms to work can address the accessibility issue for the users since few are accessible for them (Chong &Putman, 2002).

The data gathered in this criteria guided the courseware to have simple interface design and easy to follow direction. The courseware was designed with the right speed, not too fast or too slow for the pupils It was very important also for pupils with autism because they may have difficulty processing information. The courseware was designed in constant pattern and theme for structure and sequence issues. Navigation tasks and prompts were designed to be followed easily because the intended pupils have difficulty with complex set of instructions.

The fourth criterion under content quality was the “Age / Grade Level Appropriateness”. With a mean score of 4.00, all five (5) Special Education experts described age / grade level appropriateness as very important. An appropriate multimedia courseware for pupils with autism should have a reading level suitable for their age and grade level. As an appropriate courseware, it should provide directions that

clear and complete enough for learners to perform required. It is very important that the courseware's presentation of instructions is appropriate for kindergarten pupils with autism. Strategies that address the learning needs, instructional levels as well as interests of the learners are the most suited for them (Kindergarten Curricular Framework for Pupils with Autism, 2012). These are essential features of the courseware help address the level and the sensory processing of individuals with autism (Lane, et.al 2010).This also support the two best practices in early childhood mathematics said by Smith (2009) which are age appropriateness and individual appropriateness. Adapting segmentation principle, the multimedia lessons should be presented following the learner's pace segment than continuous whole unit (Gurney 2012).They require breaking down task into more manageable segments.

The data gathered from this criterion helped the researcher include short and simple design of the courseware.

The fifth criterion under content quality was "Learner Engagement/ Interactivity." With a mean score of 3.90, all five (5) Special Education experts described learner engagement/ interactivity as very important.

This supports Frith's (2003) idea that an interactive courseware should require pupils to become engaged and motivated. It should employ multimedia enhancements principles to make learning interactive (multimedia principle). It should provide appropriate and encouraging feedback throughout the instruction (voice and personalization Principle). The feedback should enable students to recognize error

committed. All these interactivity considerations from the experts could be attributed to the fact that pupils with autism have difficulty recognizing the correctness of their actions. It is very important that pupils with autism become actively engage in order to learn since they lack joint attention .Pupils with autism also lack motivation that plain text discussion may not be effective. Systematically presenting multimedia could motivate autism learners to actively participate (Gurney 2012).A computer program should be designed with the encouraging feedback since students with autism can easily be frustrated with errors. It also lessens their anxiety (Davis, et al 2007). Moreover, according to Andal (2013), pupils with autism have tendency to depend on prompts. Corrective feedbacks would be better than just warning sounds if an error is committed. Adapting the voice and personalization principles in the features could enhance the interactivity since they have difficulty recognizing the mental states of others.

With the data gathered here, the researcher considered the logic, level and types of prompts provided within the courseware to motivate and engage the learner in using the courseware. Given the perceived characteristics of autism, the researcher also adapted the voice and personalization principles with the use of a friendly human voice to provide the prompts that could increase the level of interactivity the courseware by signalling the result of user performance with the feedback.

The sixth and last criterion under content quality was “Assessment.” With a mean score of 3.70, it was described by Special Education experts as very important. A multimedia courseware assessment should be appropriate and suited to pupils with autism

since the development of math skills follows a continuum (Halpern, 2008). Through the provision of appropriate assessment procedure, the teacher can track and monitor the performance of the users. By that, enhancements could be made possible. Same with the age appropriateness, the assessment procedure within the courseware should be aligned with its educational content.

With this, the design of the courseware provided a feature that enables the teacher to track progress. A simple scoring feature in the design could help attain this.

On the other hand, the first criterion under the technical quality is "Technical Aspect" With a mean score of 3.85, all five (5) Special Education experts described technical aspect as important. The multimedia courseware should have links working properly. Its sounds and images should be aligned to the lessons and activities. All its multimedia assets should work at all times. The interface design of the courseware governs how the courseware will run. How the information will be obtainable and presented should be flawless because pupils with autism can easily be frustrated with errors. Including an encouraging feedback could lessen their anxiety when error is committed (Andal, 2013). Providing reinforcement in the form of praise could encourage the user to engage and continue with the courseware. They gain understanding that by doing a task, a positive reinforcement will be given. It is also very important that the sounds and the use of images and objects are aligned with the lessons / activities and that all multimedia resources work properly. Pupils with autism have difficulty with flexible thinking that simple technical error may lead to learning concepts in a wrong way. They

find interruptions frustrating because of their preference to sameness and structure (Mitchell & Rajendran, 2007). Yet, they may still require instructional interruptions if they find it hard to understand the task done.

With the data from this criterion, the crafted multimedia courseware was made sure that it is free from technical errors by checking all links, logics and program options.

The last criterion under the technical quality is “Graphics / Multimedia”. With a mean score of 4.00, all five (5) Special Education experts described multimedia as very important. This is in accordance with the multimedia concept which stressed that a multimedia courseware for students with autism should have background and text that are pleasing, compatible and easy to read. Its graphics should be appropriately designed to optimize the learning of pre-mathematics skills. Its graphics and animations should catch their interest. Its multimedia elements should be capable of being adjusted. For pupils with autism, the principle of *multimedia* which tells that words and pictures encourage more, than words alone are utilized. Since they lack motivation, plain text and discussion may not be effective. Systematically presenting words, pictures, sounds and animation could motivate them to actively participate (Gurney 2012).

As a multimedia courseware tailored for pupils with autism, it is also very important that background and text are pleasing, compatible and easy to read .It is also very important that graphics are consistent, appropriate and catches visual interest and appeal of individuals with autism. To make it more appealing and motivating, the courseware has a motive question as a readiness or predictability cue supported with

audio, animation and text in a digital environment. Controlling of how fast or slow they would want to go in the courseware make them feel confident as they work in the courseware with a balance of linear and nonlinear and linear elements of gameplay. Having a nonlinear play user could select the section he wants to play. Having a linear play, could permit the user to proceed to the next activity only after accomplishing the activity at hand.

An expert also suggested that the courseware for pupils with autism, despite being simple should strive to be flexible so that teachers could integrate it in any part of the lesson.

Current Level of Kindergarten Pupils Autism in terms of Pre – Mathematics and Computer Skills (Preliminary Try out)

The researcher use of the results gathered from the needs assessment and opted to utilize a PowerPoint version of the courseware. Using the validated Power Point version, the researcher determined the specific behavior characteristics; current pre- mathematics and computer skills of pupils with autism in a preliminary try out for matching the characteristics and design analysis.

Table 4.4 presents the result of the behavior characteristics observation. The table shows the behaviour characteristics of pupils with autism during the preliminary try out. Eight (8) or 80 % of pupils manifested the need for sameness or predictability while two (2) or 20% of pupils did not manifest such characteristic. Behavior manifestations were

demonstrated by saying “next” or by smiling or demonstrating self-stimulatory behaviors such as giggling and immediate performance of the task without finishing the instructions. This may be explained by the Weak Central Coherence Theory, which suggested that individuals with autism tend to sequentially process information by focusing on the fine details on parts of the stimulus causing them to overlook the big picture (Frith, 2003). Eight (8) or 80 % of pupils demonstrated sensory processing concern while two (2) did not manifest the characteristic. Behavior manifestations were showed by producing a self-induced sound like humming, being distracted by environmental sounds that are far and repeated tapping of table to produce sound. This may be attributed to the explanation given by the Sensory Processing Difficulties Theory which views that individuals under autism may have sensory processing difficulties that may result under or over reaction to stimuli (Lane et al., 2010).

Six (6) or 60 % of pupils have problems with manual dexterity shown by the difficulty in doing the “drag” task while four (4) did not manifest fine motor problem. As shared by the teacher- facilitator, most of her pupils have fine motor difficulties. Writing activities are difficult for them. She further added that majority of her pupils have difficulty on controlling the computer mouse .That is why she prefers touchscreen devices whenever integrating technology in her lesson. This can be explained by the Sensory Processing Difficulties Theory, specifically, the sensory modulation with movement sensitivity (SMMS) which is associated with specific movement function characteristics like having weak muscles and grasp poor endurance or fatigue. Eight (8)

or 80% of pupils were dependent on prompts while two (2) pupils were not. Behavior manifestations were waiting for verbal and physical prompt to finish the task, immediate answering of the question without finishing instructions and tendency rely on correction during task performance. Six (6) or 60% of pupils were frustrated with error commission while working and four (4) or 40% of pupils were not. Behavior manifestations were seen like slight wailing when given corrective feedback. Ten (10) or 100% of the pupils focused on detail and good visual processing as demonstrated by the tendency to enumerate the component of the each slide and eagerness to do the task upon seeing the familiar illustrations. Four (4) or 40% of pupils have difficulty recognizing right and wrong. Six (6) or 60% can recognize error when prompted by the teacher -facilitator. Given the following results, it was sensible to consider the suggestions from the previous literatures and studies on design considerations in designing the multimedia courseware on pre- mathematics skills.

Table 4.4
Results of the Behavior Characteristics Observation

Characteristics	Pupil										% of Yes	% of No
	1	2	3	4	5	6	7	8	9	10		
1. The pupil demonstrated need for sameness and predictability	Y	Y	Y	Y	Y	Y	Y	Y	N	N	**80**	**20**
2. The pupil demonstrated sensory processing needs (over or under stimulation to sensory stimuli)	Y	N	Y	N	Y	Y	Y	Y	Y	Y	**80**	**20**
3. The pupil demonstrated with manual dexterity fatigue and weak grasp	Y	Y	Y	Y	Y	Y	N	N	N	N	**60**	**40**
4. The pupil demonstrated prompt dependence	Y	Y	Y	Y	Y	Y	N	Y	Y	N	**80**	**20**
5. The pupil was frustrated with error commission while working	Y	Y	Y	Y	Y	Y	N	N	N	N	**60**	**40**
6. The pupil demonstrated detail -focus and good visual processing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**100**	**0**
7 The pupil had difficulty recognizing right and Wrong	Y	N	N	Y	Y	N	N	Y	N	N	**40**	**60**

The researcher also determined the pupils' current level of computer skills and looked into the way how each pupil operated the PowerPoint version during the preliminary try –out.

Table 4.5 presents the results of the computer literacy of each pupil. It reflected how the intended participants used the device to perform the PowerPoint version. Ten (10) or 100% of pupils navigated the pointer by touching the screen and dragged it to where he wanted it to. Ten (10) or 100% of the pupils clicked icon or item on the screen by tapping the screen. Ten (10) or 100% of the pupils dragged an item by using their finger. Ten (10) or 100% of the pupils started a program by tapping an icon on the screen. Ten (10) or 100% of the pupils played or used an educational software program or game when given a sequence of steps to follow. Ten (10) or 100% of the pupils used menus by tapping the screen.

The results of the checklist show that the skills of the purposively selected pupils fit for the try –out of the multimedia courseware. Furthermore, the device used to be easier to manipulate due to its touch screen function. It supported the view that more advanced technology addressed the motor difficulties of autism in manual dexterity as they can interact with the gadget (Tomorszki, 2013). Given the results of the preliminary try -out observation and the computer literacy checklist, the try –out group was capable to use the touchscreen device and supported the fact that most pupils with autism can easily be acquainted with touchscreen gadgets.

Table 4.5
Results of the Computer Literacy of the Pupils

Computer Literacy Skills	Pupil										% of Yes	% of No
	1	2	3	4	5	6	7	8	9	10		
1. Can navigate the pointer by touching the screen and drag it to where wants it to?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0
2. Can click an icon or item on the screen by tapping the screen?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0
3. Can drag an item by using his fingers	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0
4. Can start a program by tapping the screen?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0
5. Can play or use an educational software program or game when given a sequence of steps to follow?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0
6. Can play or use an educational software program or game when given a sequence of steps to follow?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0
7. Can use options by tapping the screen (e.g. saving or exiting)?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	0

Using all the data gathered from the preliminary try out and independent observation of the researcher sharing from the teacher – adviser/facilitator, a short discussion regarding the current level of pre - mathematics and computer skills of the try out group was made .Given the qualifications required to be fitted as participants for the study, ten (10) pupils with autism in the kindergarten level of Senator Claro M. Recto Memorial School. They have distinctive behavior characteristics and traits which made them unique from each other.

Pupil 1

Pupil 1 is a five -year old male with autism. He was able to answer more than half of the PowerPoint version items correctly. Some items required prompts from the teacher. It

was also observed that he has been very interested in the tablet device because of its colorful display. During the preliminary try out, he demonstrated confusion on how to operate the activity. He demonstrated prompt dependence on the teacher's cue. He also showed lack of motivation since there was no feedback coming from the courseware. One of his educational concerns is to improve the overall self-regulation specifically the pupil's hyperactivity and distractibility.

Pupil 2

Pupil 2 is a five -year old male with autism. He was able to answer more than half of the PowerPoint version items correctly. During the preliminary try out, he showed prompt dependence on the teacher's cue. He would often look back at the teacher - facilitator as if he was asking for approval. He also showed lack of motivation since there was no feedback coming from the courseware. As shared by the teacher – facilitator, the educational concerns of Pupil B are improving communication skills and increasing attention span. He also loves playing tablet games and listening to nursery rhymes. Being so much inclined with nursery rhymes, he tends to sing it during off task. Despite this, his language skills were still delayed characterized by limited word utterance and lack of the ability to initiate communication. He also has difficulty with pre- writing skills like lacing and tracing.

Pupils 3

Pupil 3 is a six - year old male with autism. He was able to answer less than of the PowerPoint version items correctly. Compared to Pupil 1 and 2, Pupil 3 was more passive and has a robot like behavior characterized by monotony and echolalia. During the preliminary try out, he showed a willingness to play when given the tablet. He has a limited attention span and distractibility. He was anticipating the feedback coming from the Power Point version. The quiet atmosphere of the PowerPoint version led his attention to other things. According to the teacher –facilitator, Pupil 3 can do tracing lines with moderate physical assistance.

Pupil 4

Pupil 4 is a seven- year old male with autism. He was able to answer more than half of the PowerPoint version items correctly. During the preliminary try out, he demonstrated eagerness at the start. Later on, he lost his attention and motivation because of the interruptions from the teacher. He also noticed that the PowerPoint version was quiet and most of the feedbacks were coming the teacher -facilitator. He demonstrated prompt dependence on the teacher's cue. He has the ability to imitate and comprehend what to do when the teacher- facilitator modelled how to do the PowerPoint activity . As shared by the teacher- facilitator, Pupil 4's activity level was one of the educational concerns because he is very passive and is lacking the willingness to initiate an activity or

communicative exchange. It was noted that despite being passive, he can be impulsive on things that are new to him He demonstrated prompt dependence on the teacher's cue.

Pupil 5

Pupil 5 is a seven -year old male with autism. He was able to answer more than half of the PowerPoint version items correctly. During the preliminary try out, he demonstrated confusion on how to operate the activity. He demonstrated fidgety every time the flow of the PowerPoint was disrupted. He also showed lack of motivation when there was no feedback from the PowerPoint. As shared the teacher- facilitator, Pupil 5 is very preoccupied with computer games to a point that he can play the same game almost all throughout the day when at home. This sharing was supported by the excitement observed when his computer literacy was assessed. He has aphasia characterized by difficulty in producing words, though he understands simple commands and instructions. He also manifested humming.

Pupil 6

Pupil 6 is an eight - year old male. He was able to answer half of the items in the PowerPoint version correctly. During the preliminary try out, Pupil 6 was noted to have limited attention span and poor impulse control in addition to body rocking and humming when seated. The teacher -facilitator employed physical prompting to regulate him. Just

like Pupil 5, Pupil 6 was also inclined to tablet games. As shared by the teacher-facilitator, Pupil 6 has difficulty with fine motor task such as writing.

Pupil 7

Pupil 7 is an eight- year old male with autism. He was able to answer almost all the items in the PowerPoint version correctly. During the preliminary try –out, he can easily manipulate the device as shown in his independence in navigating on the different parts. He laughed upon knowing that there was no feedback coming from the courseware. He just interacted with the teacher- facilitator as his form of getting feedback He even asked the teacher- facilitator why there is no audio within the device. As shared by the teacher – facilitator, Pupil 7 has difficulty in topic maintenance during conversation. He tends to talk about "out of the context" topics such as carousel and cars which affects his learning. He also showed signs of hyperactivity, impulsivity as well as body racking and tapping of table. Prompts from the teacher facilitator were necessary to manage the behaviors exhibited.

Pupil 8

Pupil 8 is an eight -year old male. He was able to answer almost all the items in the PowerPoint version correctly. He showed familiarity with the touchscreen device and was able to navigate it. He has also showed selective attention and distractibility when doing the activity in the preliminary try –out since the interaction mostly came from the teacher

–facilitator. Pupil 8 has difficulty with maintaining conversation. His educational concern was geared towards addressing his abrupt standing and obsession in church drawings. Such behaviors, limited his opportunity to learn during instructional time.

Pupil 9

Pupil 9 is a ten -year old male with autism. He was able to answer more than half of the items in the PowerPoint version correctly. During the preliminary try out, Pupil 9 demonstrated confusion on how to go through the activity. He demonstrated prompt dependence on the teacher's assistance. According to the teacher- facilitator, Pupils 9's educational concerns were improving spontaneous communication and impulsivity He showed familiarity with the touchscreen device and was willing to play it when asked to. Pupil 9 demonstrated verbal perseveration of previous things he had experienced. Necessary prompts were given to enable him to do the on the courseware. He also demonstrated impulsivity.

Pupil 10

Pupil 10 is a ten -year old male with autism. During the preliminary try out, Pupil 10 demonstrated confusion on how to go through the activity. He demonstrated prompt dependence on the teacher's assistance According to the teacher- facilitator, Pupil 10's educational concerns were improving spontaneous communication and impulsivity. He showed ease in manipulating the touchscreen device. According to the teacher- facilitator,

Pupil 10 likes staying in the computer shop together with the typically developing peers, a reason for his familiarity with the touchscreen device

4.3 Develop a multimedia courseware

After the analysis and design stage, the researcher triangulated all the information gathered from the needs assessment and preliminary try out. All the information gathered were used to develop a multimedia courseware suited to kindergarten pupils autism .The competencies included in the courseware were all of the pre-mathematics skills on Table 4.1. Regardless of the level of difficulty perceived by the Special Education teachers, all were included as the content in the eagerness to come up with a complete, ready-made supplementary multimedia courseware .In the development, the researcher and the computer programmer collaboratively worked for progress updating and checking whether the design specifications indicated are being followed. A voice talent was also hired to serve as the narrator in the courseware. The multimedia courseware was named **Ang Pamilihan ni ERVIN.** It is consisted of eight mini games that can be selected based on preference of the user. These mini games are, (1)*Pinakamaliit Hanggang Pinakamalaki* ,(2)*Mahaba, Mas Mahaba, Pinakamahaba,* (3)*Maikli, Mas Maikli, Pinakamaikli* ,(4) *Unahan, Gitna, Hulihan,* (5)*Kaliwa, Kanan, Harapan Likuran* , (6) *Barya,* (7) *Kabuuang Bilang* (8)*Pagbilang.*. It is a farm – based thematic multimedia courseware on pre-mathematics concepts. The researcher opted to use fruits and vegetables as the theme because it has a visual appeal .In addition, the researcher also noticed that teachers

commonly utilized fruits and vegetables as a theme in teaching thus, making pupils more aware of them.

The main content of the multimedia courseware such as pictures, sounds, graphics, and activities were a combination of the researcher's original work and resources from the Learning Resource Management and Development System (LRMDS), learning packages for autism and existing computer games from the internet. They were modified in such a way that they fitted the perceived characteristics of pupils with autism. Mini games/ activities were kept short and simple.

The following are parts of the multimedia courseware:

Main Menu. This part contains the title courseware, its home screen. It contains all the mini games selection panel based on the pre-mathematics skills curriculum. It also contains the multimedia options for background change and sound and music adjustment.

Background Change Option .This feature lets the select the background color the user prefers before playing.

Music Option. This feature provides control whether music will be played or not. The music adjustment is provided externally on the device. The music selected was an instrumental Bahay Kubo by FashionOfGodAskyVEVO (2011). This provides a calming music background while learning.

Audio Option. This feature provides control whether the overall sound will be played or not. The control is provided externally on the device.

Mini Game. This part includes the courseware game proper for specific

competencies that were mentioned earlier. Each mini game has the following parts:

Maaari mo ba…. Each mini game starts with the appearance of a motive question politely asking the user to play the game and help accomplish the activity specific to the mini game selected.

Instruction. This specifies the task to be done particular mini game. This is written and narrated in short and simple way.

Binabati Kita !Natapos mo na ang Gawain!. This part signifies that the user has finished the mini game .

Ito ang iyong Iskor . This part gives a simple score information.

Narrator. This feature provides friendly audio narrations as the user navigates through the courseware . Narrations were done on the courseware title, motive question, instruction , feedback , end scene and scoring information.

Emoticon. This feature provides the visual cue with a happy face for a right answer And a sad face for a wrong answer..

Hint. This provides a glow visual cue that leads to the correct answer. This activates after three consecutive mistakes were committed by the user.

4.4 Evaluate the multimedia courseware crafted by the researcher through:

4. 4.1 Experts' judgment (Special Education Teachers and IT Experts)

Ten (10) experts evaluated the multimedia in terms of content and technical quality. The Special Education experts accomplished the courseware evaluation form on content

aspect while the courseware evaluation form on technical aspects was accomplished by the Information Technology experts. Each expert was given the device / tablet with the installed multimedia courseware. Each of them was personally interviewed by the researcher and was requested to rate the multimedia courseware with ratings of 4- excellent, 3- very satisfactory, 2- satisfactory and 1 unsatisfactory.

All the experts gave suggestions and comments that improved the multimedia courseware. The majority of them said that the courseware could be very helpful not only to the Special Education schools in Lipa City but in the whole Region IV –A CALABARZON.

Tables 4.6 and 4.7 present the evaluation of the experts in terms of content and technical aspects respectively. The suggestions and comments which served as bases for revision are presented on Table 4.8.

Table 4.6 shows the weighted mean results of the courseware‘s content quality. The table implies that the criteria under the content aspects such as “Instructional Content,” “Layout”, “Accessibility”, “Age / Grade Level Appropriateness,” “Learner Engagement/ Interactivity” and “Assessment**”** met the high level of acceptability as a supplementary instructional material. The multimedia courseware gained good comments and reviews from the experts which were 4 and 3 rating in all criteria.

Under “Instructional Content,” the courseware got a mean of 4.00. This means the overall instructional content, including the directions were accurate and suited to pupils with autism. The criteria under layout got 3.48. This means that courseware‘s layout is easy to process, consistent, clear, logical and clearly defined .In terms of “Accessibility,” the

courseware obtained a mean of 3.93.This means that the courseware could accommodate the unique learning style of pupils with autism. They could also use it without much help from the teacher. It could also be easily accessible from other computer with its current specifications and system requirements. In terms of "Grade Level Appropriateness", the courseware got a mean of 4.00. This means that the courseware 's overall appropriateness including reading level , suitability and direction were suitable and clear in the context of pupils with autism. In terms of "Learner Engagement and Interactivity," it obtained a mean of 4.00. This means that the courseware 's interactivity could encourage pupils to become engaged and motivated. It employed the multimedia enhancements principles. It also provided appropriate and encouraging feedbacks which were provided throughout the instruction that enabled them to recognize error commission. Lastly, in terms of "Assessment," the courseware got a mean of 4.00 too. This means that the courseware's procedures were appropriate and the teachers could assess pupils ' progress provided within the product. The description of the means in all criteria falls under excellent which means that the content aspect of the crafted multimedia courseware is is highly acceptable as a supplementary material in pre-mathematics skills.

Table 4.6 revealed that all criteria got a score ranging from 3.40 to 4.00 which falls under the interpretation of excellent. The "Layout" criteria obtained the lowest mean. This means that the layout, especially the titles must be improved so that the pupils could process the graphics and text better. It is still suggested the importance of carefully planning the

arrangement and placement illustrations since most pupils with autism have sensory processing difficulties.

Table 4.6
Weighted Mean Results of the Courseware's Content Quality

Criteria	Evaluator					WM	INT
	1	2	3	4	5		
Instructional Content							
1. Contents were accurate, complete and current (Coherence Principle).	4	4	4	4	4	4.00	Excellent
2. All the courseware contents were the stated purpose/objective.	4	4	4	4	4	4.00	Excellent
3. Instructional content delivery was suited for pupils with autism.	4	4	4	4	4	4.00	Excellent
					Mean	4.00	Excellent
Layout							
4. Layout made it easy for the pupils to process graphics and text(Sensory Processing Disorders Theory).	4	3	3	3	4	3.40	Excellent
5. Layout was consistent in all parts(Coherence Principle).	4	4	3	3	4	3.60	Excellent
6. Layout was clear(Sensory Processing Disorders Theory).	4	3	3	3	4	3.40	Excellent
7. Layout was logical(Coherence Principle).	4	4	3	4	4	3.80	Excellent
8. Titles and subtitles were clearly defined(Sensory Processing Disorders Theory).	4	3	3	3	4	3.40	Excellent
					Mean	3.52	Excellent
Accessibility							
9. The courseware accommodated the unique learning style of pupils with autism (Weak Central Coherence Theory)	4	4	4	4	4	4.00	Excellent
10. The courseware could be used by the pupils without much help from the teacher.	4	4	4	4	3	3.80	Excellent
11. The courseware was accessible in any type of computer.	4	4	4	4	4	4.00	Excellent
					Mean	3.93	Excellent
Age / Grade Level Appropriateness							
12. Reading level was appropriate for pupils with autism.	4	4	4	4	4	4.00	Excellent
13. Product was suitable for the age and grade level of pupils with autism.	4	4	4	4	4	4.00	Excellent
14. Directions are clear and complete enough for pupils to perform required tasks Segmentation Principle).	4	4	4	4	4	4.00	Excellent
					Mean	4.00	Excellent
Learner Engagement/ Interactivity							
15. The courseware could encourage pupils become engaged and motivated	4	4	4	4	4	4.00	Excellent
16. The courseware should employ multimedia enhancements principles to make learning interactive (Multimedia Principle).	4	4	4	4	4	4.00	Excellent
17. Appropriate and encouraging feedbacks were provided throughout the instruction (Voice and Personalization Principle).	4	4	4	4	4	4.00	Excellent
18. Feedback should enabled pupils with autism to recognize error commission(Impaired Theory of Mind Theory).	4	4	4	4	4	4.00	Excellent
					Mean	4.00	Excellent
Assessment							
19. Assessment procedures were appropriate and suited.	4	4	4	4	4	4.00	Excellent
20. Teachers could assess pupils ' progress by evaluating the outcomes provided within the product.	4	4	4	4	4	4.00	Excellent
					Mean	4.00	Excellent

Table 4.7 shows the weighted mean results of the courseware's technical quality. The table revealed that the criteria under the technical quality such as "Technical Aspect" and "Graphics /Multimedia" also obtained a high level of acceptability.

In terms of "Technical Aspect" the courseware obtained a mean of 3.66. This means that despite few links and multimedia assets not working at times, the use of sounds and

images was aligned, making it still an excellent and highly acceptable supplementary material. In terms of graphics /multimedia, the courseware got a mean of 4.00.This means that the courseware's graphics and multimedia elements such as background and text were pleasing, compatible and easy to read. The graphics could catch the interest. And the multimedia elements could be capable of being adjusted.

Table 4.7 revealed that all criteria got a score ranging from 3.50 to 4.00 which fell under the interpretation excellent. The technical aspects criteria obtained the lowest score of 3.00 compared to the graphics and multimedia. This means that the technical aspects, especially the workability links and multimedia assets must be checked. It also suggested the importance of making the courseware free from technical errors.

Table 4.7
Weighted Mean Results of the Courseware's Technical Quality

Criteria	Evaluator					WM	INT
	1	2	3	4	5		
Technical Aspect							
1. All links were working properly.	3	3	3	3	3	3.00	Very Satisfactory
2. The sounds were aligned to the lessons / activities.	4	4	4	4	4	4.00	Excellent
3. The use of images was aligned to the lessons / activities.	4	4	4	4	4	4.00	Excellent
4. All multimedia assets worked at all times.	3	3	3	3	3	3.00	Excellent
					Mean	3.50	Excellent
Graphics /Multimedia							
5. Background and text were pleasing, compatible and easy to read.	4	4	4	4	4	4.00	Excellent
6. Graphics were appropriately designed to optimize learning of pre mathematics skills. Multimedia Principle).	4	4	4	4	4	4.00	Excellent
7. Graphics and animations could catch the interest of pupils with autism.	4	4	4	4	4	4.00	Excellent
8. Multimedia elements should be capable of being adjusted.	4	4	4	4	4	4.00	Excellent
					Mean	4.00	Excellent

After the courseware evaluation done by the two groups of experts, the researcher made the necessary revisions to improve the multimedia courseware. Table 4.8 gives the summary of the revisions after based on experts' judgment.

The following revisions were made all parts of the courseware: First, though the words and titles were readable, the font style in the mini game was changed to Century Gothic .As stated by one of the content evaluators:

" Maganda ang sulat. Nababasa ng isang teacher. Kaso mas maganda kung ang letters ay yung standard . Yung a *mas magada na ɑ ang sulat. This would also help in letter recognition."*

Second, one of the evaluators suggested refining the courseware layout by avoiding graphics and callouts that overlapped. Relating it to the Sensory Processing Difficulties Theory , it will have a lesser negative impact if stimulus presentation is structured. Sensory processing difficulties will have a lesser negative impact if stimulus presentation is structured (Happe & Frith, 2006). This led to the observance of boundary in the placements of assets.

In the last criteria under the technical quality, one of the Information Technology experts said that the shade of the asset pear could be the reason why few links were not working. He further added that those not working links that required several taps had one common asset, the pear. One of the Information Technology experts suggested to change the pear into avocado since it has a darker shade.

Table 4.8
Summary of Revisions based on Experts' Judgment

Feature/ Section	Comments/Suggestions	Original	Revised
Font	1. Make use of readable font with standard style for 'ɑ"	1. The courseware font style is "Garamond." Example On instruction 	1. The entire courseware font except the title /logo is change "Century Gothic." Example On instruction 
Layout	2. Avoid graphics and callouts that overlapped	2.Some of the courseware's graphics and callouts overlapped Example : 	2.Graphics and callout are adjusted Example: 
Links	3. The shade of the asset pear could be the reason why few links were not working.	3.There are parts with pear assets that are often not working not working Example 	3.The pear is changed to Avocado because of its darker shade Example: 

4.4.2 Actual Try out

The revised multimedia courseware was tried- out to ten (10) kindergarten pupils with autism. This was done to evaluate the suitability of the multimedia courseware in enhancing the pupil's motivation, attention and compliance while doing the pre-mathematics skills -related tasks. As it was previously stated by Davis et al. (2007) computer- aided instructions that attempt to have an impact should consider the

suitability of the instructional material as it address the unique needs of students with autism. They were given one hour to work on the whole courseware from mini games 1-8. Their work behaviors were observed and documented.

The teacher-facilitator, the researcher and the occupational therapist observed the way each pupil responded to the multimedia courseware in a one on one basis. The observers used the try -out evaluation form as an observation guide. This was done to confirm if the pupils really become more motivated, attentive, engaged and compliant. Going back to what Gurney (2012) said, following the multimedia principles suited on their characteristics of autism would increase their motivation, attention and compliance to do multimedia related task since it accorded to their unique needs and learning styles . Furthermore, this was accomplished to assess if pupils had demonstrated a positive feedback towards the multimedia courseware on pre-mathematics skills. Tables 4.9 to 4.18 show how each pupil responded to the multimedia courseware. Most of them had demonstrated sustained attention, improved motivation and compliance. Self-stimulatory behaviors were still seen, but undeniably, they were due to the excitement that the predictability, interactivity and entertainment that the multimedia courseware provided.

Table 4.9 shows the mean score range obtained by Pupil1 was 3.00 to 4.00.All the observers agreed that the pupil wanted to start using the courseware right away when he saw it. The pupil appeared to enjoy using the courseware. He was also seen liking the reward provided in by the courseware. On the other hand, Pupil 1 has difficulty following the instruction at the start of the program especially in using the arrow key. He was

unaware when to use the arrow key to continue with the courseware .This resulted to the assistance given by the teacher- facilitator.

This implied a need to augment the use of "next" arrow as cue to proceed.

Table 4.9
Evaluation of the Try out for Pupil 1

Criteria		Evaluators			Weighted Mean	Interpretation
		1	2	3		
1.	The pupil usually behaved appropriately while using the courseware.	4	4	3	3.67	Strongly Agree
2.	The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3.	The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4.	The pupil appeared to understand how to use the courseware.	3	3	3	3.00	Agree
5.	The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6.	The pupil was seen initiating the tasks in the courseware	3	3	3	3.00	Agree
7.	The pupil is seen to navigate with ease through the program sequence.	4	4	3	3.67	Strongly Agree
8.	The pupil seemed to be able to follow the instruction of the program with ease.	3	3	3	3.00	Agree
9.	The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10.	Cues and prompts help pupil to do the given instruction.	3	3	3	3.00	Strongly Agree
				Mean	**3.53**	**Strongly Agree**

Table 4.10 indicates the mean range obtained by Pupil 2 was 3.00 to 4.00. All the observers agreed that the pupil wanted to start using the courseware. The pupil appeared to enjoy when using the courseware. He was also seem to like the reward provided in the courseware. He was able to navigate across the different sections by grasping the meaning of the icons and graphics. It was noted that there was hesitation whether to tap the arrow because there was no "go" signal. He was also given a modelling prompt of the required response at the start of every mini game. He also demonstrated sustained attention until the end of all the mini games. He predicted the end part and smiled after seeing it flashed. Pupil 2 demonstrated good sitting on -task behavior. He appeared very motivated by the multimedia elements such as the music and animation. He also

demonstrated sustained attention. He needed modelling of the task at the start of every mini game. There were few instances that he had difficulty recognizing the hint glow. This resulted to a wrong answer despite the hint provided. These results implied a need to augment the arrow key and provide a tutorial screen so that the pupil could see how to do each mini game first. Furthermore, there was a need revise the glow hint into a more recognizable prompt so the pupil would be aware when directed to the correct answer.

Table 4.10
Evaluation of the Try out for Pupil 2

Criteria		Evaluators			Weighted Mean	Interpretation
		1	2	3		
1.	The pupil usually behaved appropriately while using the courseware.	4	4	3	3.67	Strongly Agree
2.	The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3.	The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4.	The pupil appeared to understand how to use the courseware.	3	3	3	3.00	Agree
5.	The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6.	The pupil was seen initiating the tasks in the courseware.	3	3	3	3.00	Agree
7.	The pupil is seen to navigate with ease through the program sequence.	3	3	3	3.00	Agree
8.	The pupil seemed to be able to follow the instruction of the program with ease.	3	3	3	3.00	Agree
9.	The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10.	Cues and prompts help pupil to do the given instruction.	3	3	3	3.00	Agree
				Mean	**3.47**	**Strongly Agree**

Table 4.11 shows the mean range obtained by Pupil 3 was 3.00 to 4.00. All the observers agreed that the pupil appeared wanting to start using the courseware and was enjoying it. It was also observed that he liked using the courseware as he smiled when playing particularly when seeing the happy emoticon. He misunderstood that the happy and sad face due their similarity in color. On the other hand, Pupil 3 needed assistance from the teacher – facilitator. It was noted that there was hesitation on the part of Pupil 3 whether to tap the arrow because there was no signal to proceed. The prompts and cues provided in the courseware seemed enough to do the tasks and activities independently

though modelling was needed at the starting part. Pupil 3 had sustained his attention and focus especially upon learning the task specific the min game mini game. He also had decreased distractibility as seen when he ignored some of the teacher – facilitator's commands and prompts. He anticipated the feedback from the courseware and showed pleasure upon hearing and seeing it.

This implied a need to augment the use of next arrow similar to the concern stated previously. The results also implied a need to revise the emoticon to make it more distinct from each other.

Table 4.11
Evaluation of the Try out for Pupil 3

Criteria		Evaluators			Weighted Mean	Interpretation
		1	2	3		
1.	The pupil usually behaved appropriately while using the courseware.	4	4	3	3.67	Strongly Agree
2.	The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3.	The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4.	The pupil appeared to understand how to use the courseware.	3	3	3	3.00	Agree
5.	The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6.	The pupil was seen initiating the tasks in the courseware	3	3	3	3.00	Agree
7.	The pupil is seen to navigate with ease through the program sequence.	2	2	2	3.00	Agree
8.	The pupil seemed to be able to follow the instruction of the program with ease.	3	3	3	3.00	Agree
9.	The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10.	Cues and prompt help pupil to do the given instruction.	3	3	3	3.00	Agree
				Mean	**3.47**	**Strongly Agree**

Table 4.12 shows the mean range obtained by Pupil 4 was 3.00 to 4.00. Pupil 4 appeared wanting to start using the courseware and eventually enjoyed it. Pupil 4 demonstrated an understanding how to use the courseware. It was also observed that he liked using the courseware as he smiles when playing particularly upon hearing the verbal praises. On the other hand, the prompts and cues provided in the courseware seemed not enough to do the tasks and activities independently. This issue resulted in a decreased

initiative to the tasks on the courseware at the start. The teacher -facilitator modelled the required response first. Pupil 4 also demonstrated request approval by looking at the teacher. Upon gaining familiarization, he seemed to enjoy and increase his initiative to the activities.

Table 4.12
Evaluation of the Try out for Pupil 4

Criteria		Evaluators			Weighted Mean	Interpretation
		1	2	3		
1.	The pupil usually behaved appropriately while using the courseware.	4	4	4	4.00	Strongly Agree
2.	The pupil appeared wanting to start using the courseware	3	3	3	3.00	Agree
3.	The pupil appeared to enjoy using the courseware.	3	3	3	3.00	Agree
4.	The pupil appeared to understand how to use the courseware.	3	3	3	3.00	Agree
5.	The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6.	The pupil was seen initiating the tasks in the courseware	3	3	3	3.00	Agree
7.	The pupil is seen to navigate with ease through the program sequence.	3	3	3	3.00	Agree
8.	The pupil seemed to be able to follow the instruction of the program with ease.	3	3	3	3.00	Agree
9.	The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10.	Cues and prompt help pupil to do the given instruction.	3	3	3	3.00	Agree
				Mean	**3.30**	**Agree**

Table 4.13 shows the mean range obtained by Pupil 5 was 4.00 in all criteria. The pupil appeared wanting to start using the courseware and eventually enjoyed it. He also demonstrated understanding how to use the courseware. It was also observed that he liked using the courseware as he smile when playing especially upon hearing the verbal praises and seeing emoticons. The prompts and cues provided in the courseware made him do the tasks and activities independently. These resulted to task initiative. Being very preoccupied by computer and tablet games, he demonstrated excitement. He also still hummed while using the courseware but the observers perceived it as a result of

excitement. Fidgety was also not observed. He enjoyed playing the courseware and was very attentive until the end.

Table 4.13
Evaluation of the Try out for Pupil 5

Criteria	Evaluators			Weighted Mean	Interpretation
	1	2	3		
1. The pupil usually behaved appropriately while using the courseware.	4	4	4	4.00	Strongly Agree
2. The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3. The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4. The pupil appeared to understand how to use the courseware.	4	4	4	4.00	Strongly Agree
5. The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6. The pupil was seen initiating the tasks in the courseware	4	4	4	4.00	Strongly Agree
7. The pupil is seen to navigate with ease through the program sequence.	4	4	4	4.00	Strongly Agree
8. The pupil seemed to be able to follow the instruction of the program with ease.	4	4	4	4.00	Strongly Agree
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10. Cues and prompt help pupil to do the given instruction.	4	4	4	4.00	Strongly Agree
			Mean	**4.00**	**Strongly agree**

Table 4.14 shows the mean range obtained by Pupil 6 ranged from 3.00 to 4.00. The pupil appeared wanting to start using the courseware and demonstrated understanding how to use the courseware. Just like the other pupils, he needed the assistance of the teacher at the start to be familiar with the flow of the courseware. The prompts and cues were enough, yet, there was hesitation on how to go about after the motive question. He was compliant and was seen to be attentive as the teacher initially modelled how to do the mini game. Fidgety was also not observed. He enjoyed playing the courseware and was very attentive until the end. The results strengthened the implication to have a tutorial screen to aid the navigation across the courseware

Table 4.14
Evaluation of the Try out for Pupil 6

Criteria	Evaluators			Weighted Mean	Interpretation
	1	2	3		
1. The pupil usually behaved appropriately while using the courseware.	3	3	3	3.00	Agree
2. The pupil appeared wanting to start using the courseware	4	4	3	3.67	Agree
3. The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Agree
4. The pupil appeared to understand how to use the courseware.	3	3	3	3.00	Agree
5. The pupil seemed to like the rewards in the courseware.	3	3	3	3.00	Agree
6. The pupil was seen initiating the tasks in the courseware	3	3	3	3.00	Agree
7. The pupil is seen to navigate with ease through the program sequence.	3	3	3	3.00	Agree
8. The pupil seemed to be able to follow the instruction of the program with ease.	3	3	3	3.00	Agree
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	3	3	3	3.00	Agree
10. Cues and prompt help pupil to do the given instruction.	3	3	3	3.00	Agree
			Mean	**3.20**	**Agree**

The table 4.15 shows the mean range obtained by Pupil 7 obtained 4.00 weighted mean in all criteria. The pupil appeared wanting to start using the courseware and enjoyed it. He also demonstrated understanding how to use the courseware. It was also observed that he liked using the courseware. He smiled when playing, especially upon hearing the verbal praises and seeing emoticons. The prompts and cues provided in the courseware made him navigate across the different parts of the courseware.

Table 4.15
Evaluation of the Try out for Pupil 7

Criteria	Evaluators			Weighted Mean	Interpretation
	1	2	3		
1. The pupil usually behaved appropriately while using the courseware.	4	4	4	4.00	Strongly Agree
2. The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3. The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4. The pupil appeared to understand how to use the courseware.	4	4	4	4.00	Strongly Agree
5. The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6. The pupil was seen initiating the tasks in the courseware	4	4	4	4.00	Strongly Agree
7. The pupil is seen to navigate with ease through the program sequence.	4	4	4	4.00	Strongly Agree
8. The pupil seemed to be able to follow the instruction of the program with ease.	4	4	4	4.00	Strongly Agree
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10. Cues and prompt help pupil to do the given instruction.	4	4	4	4.00	Strongly Agree
			Mean	**4.00**	**Strongly Agree**

Table 4.16 shows the mean range obtained by Pupil 8 obtained 4.00 weighted mean in all criteria. The pupil appeared wanting to start using the courseware and enjoyed it. He also demonstrated understanding how to use the courseware. He smiled upon hearing the verbal praises and seeing the emoticons. The prompts and cues provided in the courseware enabled him to navigate across the different parts of the courseware. Pupil 8 demonstrated good work behaviors characterized by good sitting -on task behavior and sustained attention on the courseware.

Table 4.16
Evaluation of the Try out for Pupil 8

Criteria	Evaluators			Weighted Mean	Interpretation
	1	2	3		
1. The pupil usually behaved appropriately while using the courseware.	4	4	4	4.00	Strongly Agree
2. The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3. The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4. The pupil appeared to understand how to use the courseware.	4	4	4	4.00	Strongly Agree
5. The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6. The pupil was seen initiating the tasks in the courseware	4	4	4	4.00	Strongly Agree
7. The pupil is seen to navigate with ease through the program sequence.	4	4	4	4.00	Strongly Agree
8. The pupil seemed to be able to follow the instruction of the program with ease.	4	4	4	4.00	Strongly Agree
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10. Cues and prompt help pupil to do the given instruction.	4	4	4	4.00	Strongly Agree
			Mean	**4.00**	**Strongly Agree**

Table 4.17 shows the mean range obtained by Pupil 9 obtained 4.00 weighted mean in all criteria. The pupil appeared wanting to start using the courseware and enjoyed it. He also demonstrated understanding how to use the courseware. He liked the rewards or praises given by the courseware and as he smiled while playing specially upon seeing the happy emoticon. The prompts and cues provided in the courseware enabled

him to navigate across the different parts of the courseware. He demonstrated sustained attention until the end. Verbal perseveration was not observed when playing the multimedia courseware.

Table 4.17
Evaluation of the Try out for Pupil 9

Criteria	Evaluators			Weighted Mean	Interpretation
	1	2	3		
1. The pupil usually behaved appropriately while using the courseware.	4	4	4	4.00	Strongly Agree
2. The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3. The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4. The pupil appeared to understand how to use the courseware.	4	4	4	4.00	Strongly Agree
5. The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6. The pupil was seen initiating the tasks in the courseware	4	4	4	4.00	Strongly Agree
7. The pupil is seen to navigate with ease through the program sequence.	4	4	4	4.00	Strongly Agree
8. The pupil seemed to be able to follow the instruction of the program with ease.	4	4	4	4.00	Strongly Agree
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10. Cues and prompt help pupil to do the given instruction.	4	4	4	4.00	Strongly Agree
			Mean	**4.00**	**Strongly Agree**

Table 4.18 shows the mean range obtained by Pupil 10 obtained 4.00 weighted mean in all criteria. He also demonstrated understanding how to use the courseware and to continuously played it without much help from the teacher. He also understood the meaning of the verbal praises .It was also observed that he liked using the courseware as he smiled when playing, especially upon hearing the repeated predictable verbal praises.

Table 4.18
Evaluation of the Try out for Pupil10

Criteria	Evaluators			Weighted Mean	Interpretation
	1	2	3		
1. The pupil usually behaved appropriately while using the courseware.	4	4	4	4.00	Strongly Agree
2. The pupil appeared wanting to start using the courseware	4	4	4	4.00	Strongly Agree
3. The pupil appeared to enjoy using the courseware.	4	4	4	4.00	Strongly Agree
4. The pupil appeared to understand how to use the courseware.	4	4	4	4.00	Strongly Agree
5. The pupil seemed to like the rewards in the courseware.	4	4	4	4.00	Strongly Agree
6. The pupil was seen initiating the tasks in the courseware	4	4	4	4.00	Strongly Agree
7. The pupil is seen to navigate with ease through the program sequence.	4	4	4	4.00	Strongly Agree
8. The pupil seemed to be able to follow the instruction of the program with ease.	4	4	4	4.00	Strongly Agree
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.	4	4	4	4.00	Strongly Agree
10. Cues and prompt help pupil to do the given instruction.	4	4	4	4.00	Strongly Agree
			Mean	**4.00**	**Strongly Agree**

4.5 Finalize the multimedia courseware based on evaluation results

To finalize the multimedia courseware, the researcher reflected on the comments and suggestions on the performance of the kindergarten pupils with autism based on the try -out evaluation form. The researcher, teacher- facilitator and the occupational therapist conferred and come up with suggestions and comments to improve the multimedia courseware Table 4.19 shows two comments from the teacher -facilitator and occupational therapist. Both of them suggested adding prompts after each motive question on the arrow key that would enable the students to tap that icon to proceed to the next level. Magnifying it would be better. This could address the prompt dependence from the teacher thus could lead to independence. It was also suggested to change the emoticons to enable better distinction as one of the pupils mistaken it to be similar. The color of the sad face must be changed from yellow to red. It was also suggested to change the hint into a bulb since there are pupils who were still unable to tap the correct answer when the glow hint appeared after three mistakes. The occupational therapist also suggested also if it could be possible to have a narration and picture option mode .It was noted that some pupils were not responding to the printed text but on the images and audio narrations.

A tutorial screen after the motive question on each mini game would give the pupil idea on how to do the activities in each mini game since there were pupils who were given a modelling prompt by teacher facilitator at the start .The provision of a

tutorial screen gives pupils with autism a visual model before the actual performance of a task.

Table 4.19
Summary of Revisions after the Try out

Feature/Section	Comments/Suggestions	Original	Revised
Motive Question Arrow key on the motive question	1. Add prompts to the arrow key on the Motive Question. Make it magnified.	1. The arrow key on the motive questions is manually controlled with no signal when to proceed. 	1. The arrow key is magnified after the motive question was narrated. 
Emoticons	2. Change the color of sad face to enable better distinction.	2. The sad face is color yellow . 	2. The sad face is changed to red . 
Hint	3. Change the glow hint to bulb to make it more recognizable.	3. Glow hint is used to lead the pupils to the correct answer. 	3. The glow hint is changed to bulb. 
Additional feature Narration and Picture Mode Tutorial Screen after the motive question in each mini game	4. Have a narration and picture mode since some pupils were not responding to the printed text but on the images and audio narrations. 5. Provide a tutorial screen after the motive question on each mini game.	4. No narration and picture mode were offered.  5. No tutorial screen after the Motive Question .	4. A narration and picture mode option is provided  5. Tutorial screen is added after the motive question in each min game. 

4.5.1 Presentation of Multimedia Courseware on Pre-Mathematics Skills

Rationale

The multimedia courseware was developed to come up with an appropriate technology that hopes to contribute to the education of pupils with autism specifically, aid in learning of pre-mathematics skills. Limited technologies were designed and made specifically for pupils with autism. Furthermore, there is no technology- based material specifically designed for them. The developed multimedia courseware is duty-bound to aid pupils with autism, special education teachers, their parents, educational researchers and other professionals as well. Pupils with autism can attain a good work behavior while learning the pre-mathematics skills since the design features had carefully considered the way they think, behave and process information. The systematic presentation and provision of multimedia elements and the overall design features of the courseware aims also to help parents have an active educational involvement through follow up at home since the courseware is accessible in an affordable device. The multimedia courseware could be integrated in different parts of the lesson. It could be used as a supplementary tool for pre- assessment and assessment part the lesson depending on the preference of the teacher. The multimedia courseware could also be used by other special education professionals handling pupils with autism with its unique features that could not only target pre-mathematics skills but also auditory processing skills.

Theoretical Framework

The developed multimedia courseware on pre-mathematics skills were anchored on Weak Central Coherence Theory, Impaired Theory of Mind Theory, Sensory Processing Difficulties Theory and adapted principles of Cognitive Multimedia Learning Theory suited for autism. First, the Weak Central Coherence Theory made use of computer- aided instruction in a form of a courseware, the delivery system of the learning contents in pre-mathematics skills. It was also reflected on the use of actual pictures to enable better generalizations. The courseware's simplicity in both design options and functions makes it an ideal learning tool for pupils with autism. The other feature that was guided by weak central coherence was the logic of the courseware .The courseware was designed to open one program at a time. Tasks and activities were isolated. Each finger tap or swipe produces a single action, and the device only allows separate, sequential actions. The instructions to be performed are short for easier processing of information .The sections in the environment are structured for pupils with autism. Repetition was also employed in the presentation and design of the different sections. Second, the Impaired Theory of Mind Theory was applied in provision of emoticons like happy and sad face to signal the correctness of response. This is also to address the predictability issues with regard to the social deficiency associated with autism. The use of motive question as a cue addresses their social deficits by encouraging interaction. Third, the Sensory Processing Difficulties Theory made use of simple presentation and limited display. The courseware's sound option and

background color could be adjusted and changed as to address the difficulty in processing the stimuli and information. And the last theory that shaped the framework of this research was the Cognitive Multimedia Learning Theory specifically the adapted principles of Cognitive Multimedia Learning suited for children with autism. The courseware made use of *segmentation* that presented multimedia lessons in learner's pace segment. *Personalization* made use of conversational style in narration. *Coherence* observed that only necessary materials are included. Text and graphics that are relevant materials were combined and aligned with the delivery of instructions. *Modality* made use of printed text and narration. *Multimedia* made use of words and pictures and *voice* made use of friendly human voice in the narration.

Description of the Multimedia Courseware on Pre-Mathematics Skills for Kindergarten Pupils with Autism (Ang Pamilih ni ERVIN)

Ang Pamilihan ni ERVIN is a multimedia courseware designed and developed specifically for kindergarten pupils with autism.Its main purpose is to provide a suitable supplementary material on teaching pre-mathematics skills. With its unique design, the multimedia courseware aims to improve the learning behaviour of pupils of pupils. Each mini game has its own activities to be accomplished. The courseware integrates the systematic use of multimedia instruction and interactivity in a drill game in encouraging pupils to learn pre-mathematics concepts in a motivating and engaging way. These pre-mathematics concepts were lifted from the Curricular Framework for Kindergarten Pupils

with Autism (2012 by the Department of Education. It consists of eight mini games that can be selected based on the preference of the user. Each mini game has its specific activity /objective:

1. **Pinakamaliit Hanggang Pinakamalaki .**This involves arranging the fruits and vegetable in the order of size from smallest to largest.
2. **Mahaba, Mas Mahaba**. **Pinakamahaba**, This involves selecting long, longer, longest from the group of fruits and vegetables .
3. **Maikli, Mas Maikli, Pinakamaikli**. This involves selecting short, shorter, shortest from the group of fruits and vegetables.
4. **Unahan, Gitna, Hulihan**. This involves locating first, middle and last in the group of fruits and vegetables.
5. **Kaliwa, Kanan, Harapan Likuran**. This involves locating which fruit or vegetable faces front and back, left or right of the narrator .
6. **Barya**. This involves pointing the coins: one, two, five, ten, twenty and five when instructed by the narrator.
7. **Kabuuang Bilang**. This involves constructing sets of one, two, and three up to ten fruits or vegetables by dragging them to the basket.
8. **Pagbilang**. This involves counting orally from 1 to 10 by tapping the center of the tree. After each tap, an apple will dropped and counts in increment.

The below are the parts / features of the multimedia courseware:

Main Menu. This part contains the title courseware, its home screen. It contains all the mini games selection panel based on the adapted pre – mathematics curriculum for kindergarten pupils with autism . It also contains the multimedia options for background change, sound and music adjustment and narration and picture mode option.

Narration and Picture Mode. This feature lets the user select whether he / she prefers that all the text on the mini games be removed leaving only pictures and narration during play.

Background Change Option. This feature lets the user select the background color he / she prefers before playing.

Music Option. This feature provides control whether music will be played. The adjustment music is provided externally on the device.

Audio Option. This feature provides control whether the overall sound will be played or not. The music adjustment is provided externally on the device.

Mini Game. This part includes the courseware game proper for specific competencies that were mentioned earlier. Each mini game has the following parts;

Maaari mo ba…. Each mini game starts with the appearance of a motive question politely asking the user to play the game and help accomplish the activity specific to the mini game selected .

Halimbawa. This provides the user with a tutorial screen of the task specific to each mini game.

Instruction. This specifies the task to be done particular mini game. This is written

and narrated in short and simple way.

Binabati Kita !Natapos mo na ang Gawain!. This part signifies that the user has finished the mini game .

Ito ang iyong Iskor. This part gives a simple score information .

Narrator. This feature provides friendly audio narrations as the user navigates through the courseware . Narrations are provided on the courseware title, motive question, instruction, feedback, end scene and competency assessment.

Emoticon. This feature provides the visual cue whether an answer is right or wrong. The happy face is color red while sad face is color yellow.

Hint. This provides a bulb visual cue that leads to the correct answer. This activates after three consecutive mistakes committed by the user.

For the sample of the finalized multimedia courseware, and teacher‘s manual guide (see Appendix T, U and V p. 168, 184 and 190)

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions and recommendations of the study.

5.1 Summary

The general purpose of this study is to develop a multimedia courseware on pre-mathematics skills for pupils with autism. Specifically the study sought to identify the content of the multimedia courseware for pupils with autism , design the multimedia courseware based on review of design considerations from previous studies and suggestions from experts, develop a multimedia courseware, evaluate the multimedia courseware crafted by the researcher through experts' judgment and actual try out and finalize the multimedia courseware based on evaluation results. The researcher was motivated to conduct the study due the limited local instructional technology specifically made for pupils with autism. The research also saw the need to address their learning behavior in pre-mathematics concepts essential which are for learning more complex math concepts in the future.

The study made use of the descriptive-developmental research design utilizing the ADDIE Model of Instructional Design. It followed the stages to come up with the development of multimedia courseware on pre-mathematics skills the first stage is analysis.

In this stage, the level of difficulty of pre-mathematics skills was identified to come up with ideas on the content of the courseware. The researcher also identified the current level of the pupils in terms of pre-mathematics and computer skills in a preliminary try out with the use of a PowerPoint version of the courseware. The second stage is the design. This is where all the data gathered from the previous stage was carefully considered. The appropriate multimedia elements and features like background color, picture animation, transition , type of response , music and sounds, instructional program flow, level of multimedia interaction and minimum system requirements make the courseware work were all detailed further.. The third stage is development. In this stage, the researcher asked the assistance of a computer programmer to code the design features into the first model of the multimedia courseware and was evaluated by ten (10) experts in terms of content and technical quality using four -point rating scale. The fourth stage is implementation / actual try out. In this stage, the crafted multimedia courseware was tried-out to ten (10) purposely selected pupils in the kindergarten level. The fifth and last of the stages is evaluation and finalization. It is the stage where the courseware was revised and finalized after its actual try out to kindergarten pupils with autism.

Ten (10) pupils with autism were involved in the actual try out. Five (5) Special Education teachers evaluated pre –mathematics skills level of difficulty. Five (5) experts validated the research instruments. Five (5) Special Education professionals validated the content of the Power Point version .Ten (10) experts evaluated the multimedia courseware in terms of content and technical aspects and three (3) experts evaluated the try out. The

research was conducted from the fourth quarter of the school year 2014-2015 up to third quarter of the present school year 2015-2016 at Senator Claro M. Recto Memorial School Special Education Center.

5.2 Findings

Based on the analysis and interpretation of data, the following findings were shown:

1. Six (6) of the eight learning competencies were perceived difficult and two (2) learning competencies were deemed easy for pupils with autism.These difficult competencies were selecting long, longer, longest from group of objects, selecting short, shorter, shortest from group of objects, locating first, middle and last in group of object, locating front and back, left and right. Naming coins: one, two, five, ten, twenty five, etc. and constructing sets of one, two, and three up to ten objects hand the easy competencies were arranging objects in the order of size from smallest to largest and counting orally from 1 to 10. This implied that much of the pre-mathematics skills should still need to be improved among kindergarten pupils with autism.

2. Review of related studies on design consideration implied that the pupils with autism‘s need for sameness and predictability , sensory processing needs, problems with manual dexterity fatigue, weak grasp, prompt dependence, frustration with technical errors, detail –focus and good visual processing and difficulty to recognizing right and wrong should be considered . Likewise, Special Education experts perceived as very important that in the design of the multimedia courseware the instructional content, layout, accessibility,

age / grade level appropriateness, learner engagement, assessment, technical aspect and graphics and multimedia and should be given much consideration. In the courseware‘s instructional content, the accuracy, completeness and relatedness should be observed. In the layout, the processing easiness and clearness should be considered .In the age and grade level appropriateness, the reading level suitability and clearness of directions were considered .In the learner engagement and interactivity, the courseware’s ability to engage and motivate the learners were considered. In assessment, the procedure’s suitability should be considered. In the technical aspect, the workability of links and alignment of sounds and images were considered. Lastly, in the graphics and multimedia, the visual appeal, appropriateness as well the multimedia capability to be adjusted was carefully considered. Experts also suggested that the multimedia courseware be short and concise due to the limited attention span of pupils with autism.

3. All the pre –mathematics learning competencies on the curriculum for kindergarten pupils with autism were included as the content of the multimedia courseware. The main contents of the multimedia courseware were from sources such as Learning Resource Management and Development System (LRMDS), learning packages, internet computer games .The multimedia courseware is consisted of the home screen, selection panel, background change, audio and music options that can be adjusted. It also includes the game proper for the specific learning competency, motive questions, and short instructions ending markers, scoring information, audio narrations, encouraging feedbacks emoticons

and hints. The assistance of a computer programmer was necessary to meet design specifications in computer programming.

4. All the criteria under the content and technical quality were rated excellent. This implied a high level of acceptability of the courseware as a supplementary instructional material. From the evaluation of the Special Education and Information Technology experts, the font style in the mini game need to be changed to into a standard font style that would help pupils with autism in letter recognition. Overlapping layout and callout were removed by observing proper boundary adjustment. Lastly, an asset was changed to avoid links that are not working. After revision, the courseware was easier to process and the malfunctioning links were minimized and removed.

5. The implementation/ try out revealed that the pupils with autism had demonstrated sustained attention, improved motivation and compliance. Self-stimulatory behaviors were seen but, they were due to excitement that the predictability, interactivity and entertainment that the multimedia courseware provided. Few pupils required additional prompts such as initial demonstration on how to accomplish the specific task. It was also revealed that there were few pupils that misunderstood the visual prompts and cues provided such as the emoticons and the hints. Moreover, there were pupils that relied mostly on the auditory narrations and pictures rather than the printed text.

6. Final revisions were made on some parts and assets such as additional visual cue for the arrow. Additional features were also provided such as tutorial screen and picture and

narration mode. Special Education experts and Information Technology experts who were involved in the evaluation contributed essential comments and suggestions on the study.

4.5 Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. Special Education experts are really in need of a complete suitable multimedia courseware that will put emphasis on improving the learning behaviors and skills of pupils with autism since they were perceived to have difficulty with most of the pre – math skills competencies following the Department of Education standards.

2. Multimedia courseware design should consider the review of previous studies. Furthermore, it should also consider autism‘s unique behaviors and sensory processing characteristics as well as the multimedia courseware ‘design criteria.

3. The multimedia courseware was developed following the ADDIE Model, which enabled the researcher to engage in a systematic process of identifying the content and design considerations to be specified for the development of the multimedia courseware. The assistance of a computer programmer is necessary to handle the technical issues in computer programming.

4. Evaluation of the multimedia courseware through experts’ evaluation is necessary to improve the courseware for pupils with autism.

5. Pupils with autism who used a suitable multimedia courseware based on their characteristics had sustained attention, improved their motivation and compliance.

6. A multimedia courseware based on evaluation of Special Education teachers handling pupils with autism, Information Technology experts and actual try out is a supplementary material that could develop and enhance the learning behaviors of pupils with autism.

5.4 Recommendations

In the light of the findings of the study, the researcher recommends that:

1. the learning characteristics and behavior of pupils with autism be considered in enhancing the design and content of the courseware.

2. the design from considerations from previous studies and suggestions from previous studies be reviewed to design or re-design other multimedia coursewares.

3. a multimedia courseware be developed for pupils with autism with the help of other professionals like the computer programmer. Hence, an interdisciplinary approach in conducting instructional materials development for pupils with autism be undertaken.

4. the courseware developed by the researcher be evaluated further for enhancement of content and design.

5. a similar study be conducted using more participants and those with other exceptionalities.

6. a multimedia courseware that covers other subjects or learning competencies be developed. This would help pupils with autism improve in their behavior while learning and have an engaging and motivating way of learning certain skills.

7. other similar researches be undertaken to address the perceived limitations of this study .

REFERENCES

Adam, T., & Tatnall, A. (2008). Using ICT to improve the education of students with learning disabilities. Learning to Live in the Knowledge Society . 63-70 doi: 10.1007/978-0-387-09729-9_8

Algrim-Delzell, L., Agnello, B., Jimenez, B. & Knight, V. (2009). Research-based practices for creating access to the general curriculum in mathematics for students with significant intellectual disabilities. Retrieved from http://www.ccsso.org/Resources/Publications/Research-based_Practices_for_Creating_Access_to_the_General_Curriculum_in_Mathematics_for_Students_with_Significant_Intellectual_Disabilities.html

Alongtaga, J. (2009). A computer-assisted instruction (CAI) module on enhancing numeracy skills of preschoolers with attention deficit hyperactivity disorder Retrieved,from http://www.jitbm.com/Volume2No1/A%20CAI%20Module%20on%20Enhancing%20Numeracy%20Skills%20of%20Preschoolers%20with%20ADHD%20%282%29.pdf

American Psychiatric Association. (2000). Diagnostic and statistical manual of mental disorders: DSM-IV-TR. Washington, DC: American Psychiatric Association.

Ang, C., & Zaphiris, P. (2005). Developing enjoyable second language learning software tools. A computer game paradigm. User-Centered computer aided learning language. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.140.5209&rep=rep1&type=pdf

Andal, A. (2013). Design considerations for developing an educational multimedia storytelling courseware for children with autism. Annual International Conference on Infocomm Technologies in Competitive Strategies. 2013, p139-147. 9p. doi: 10.5176/2251-1814_EeL13.66

Andal. A(2014). Development and evaluation of an educational multimedia storytelling courseware for children with autism. Master's thesis. De La Salle University. Manila.: Philippines.

Asccroft, W. Agrrio , S &Keohane, J, (2010). Successful strategies for teaching kids with autism. USA: Profrock Press Inc.

Attwood, T. (2007). The complete guide to Asperger's syndrome. London : Kingsley.

Autism Society Philippines. (2012). Autism (Brochure). Quezon City. Philippines.

Bach, J. & Miller, K. (2001). Software Evaluation Checklist. Retrieved from http://www.ncsu.edu/midlink/sw.checklist.pdf

Bahl, R. (2012). Adaptive-addie: Framework for instructional systems design. Retrieved, http://blogs.ubc.ca/ranvir/files/2012/08/Ranvir_Bahl_Scholory_Essay-ETEC-511.pdf

Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (2001). Enhancing social problem solving in children with autism and normal schildren through computer-assisted instruction. Journal of Autism and Developmental Disorders, 31, 377-384.

Boreman, K. & Rucker, D. (n.d.) Pre number and number concept for young children. Retrieved from http://static0.shopify.com/s/files/1/0001/5601/files/NAEYC.keynote.pdf.

British Association for Early Childhood Education. (2012). Early Years Foundation Stage Framework. Retrieved from http://www.foundationyears.org.uk/files/2012/03/Development-Matters-FINAL-PRINT-AMENDED.pdf

Chen, Y., Rodgers, J., & McConachie, H. (2009). Restricted and repetitive behaviors, sensory processing and cognitive style in children with autism spectrum disorders. Journal of Autism & Developmental Disorders, 39(4), 635-642. doi:http://dx.doi.org/10.1007/s10803-008-0663-6

Chong, L. & Putnam, C. (2002). Software technologies designed for people with autism:What do users want?. Retrieved from http://depts.washington.edu/ddi/publications/Putnam_Chong.pdf

Darcen , A. (2001). Development and validation of reading courseware for Filipino Children with autism (Unpublished Master's Thesis). Philippine Normal University, Manila.

Davis, M., Otero, N., Dautenhahn, K.; Nehaniv, C.L. Powell, S.D. (2007). Creating a software to promote understanding about narrative in children with autism: Reflecting on the design of feedback and opportunities to reason," Development and Learning. IEEE 6th International Conference on Education Technology .64-

69, doi: 10.1109/DEVLRN.2007.4354045 Retrieved from http http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=4354045&isnumber=4354021&url=http%3A%2F%2Fieeexplore.ieee.org%2Fstamp%2Fstamp.jsp%3Ftp%3D%26arnumber%3D4354045%26isnumber%3D4354021

Department of Education. (2012). Curricular framework for kindergarten children with autism. Retrieved from https://www.scribd.com/doc/232221154/k-to-12-Framework-for-Kcwa

Department of the Education. (2009). Inclusive education as a strategy for increasing participation rate of children with special needs. Order No. 72.Retrieved from http://www.Department of Education.gov.ph/sites/default/files/order/2009/DO_s2009_72.pdf

Dizon, E (n.d). Helping learners with Special Educational needs achieve in the inclusive school (k-12).Retrived from http://www.studentfindlpc.com/Helping%20Learners%20with%20Special%20Educational%20Needs%20Achieve%20in%20the%20Inclusive%20School%20(K-12)_14th%20NSC%20Consolidated%20paper.docx

Dizon, E. & Sacris, C. (2002). Individualization of educational contents and strategies. Metro Manila:Verjon Enterprises.

Dun, W. & Tomchek, S. (2007). Sensory processing in children with and without autism: Comparative study using the short sensory profile. Retrieved from http://www.spdfoundation.net/pdf/tomcheck_dunn.pdf

Emiliani, P. L. (2006) Assistive technology (AT) versus mainstream technology (MST): The research perspective. Technology and Disability. 18, 19-29.

FashionOfGodAskyVEVO (2011, October 8). *J'sky band - bahay kubo (official instrumental)* (Video file). Retrieved from https://www.youtube.com/watch?v=vhXK3W94xbw

Frith U. (2003). Autism : Explaining the enigma (2nd ed.)Malden ,MA:Blackwell.

Friend, M. (2011). Special Education: Contemporary perspectives for school professionals (3rd ed.). Upper Saddle River, N. J.: Pearson.

Goldsmith, T. R., & Leblanc, L. A. (2004). Use of technology in interventions for

students with autism. Journal of Early and Intensive Behavior Intervention, 1(2), 166-178.Retrieved from http://files.eric.ed.gov/fulltext/EJ848688.pdf

Grandin, T. (2006). Thinking in pictures with updates from the expanded edition. Retrieved from http://www.grandin.com/inc/visual.thinking.html

Gurney, P(8,October 2012). Storyboard reflection. (Blog post). Retrieved from https://prezi.com/ss4gtbkgzrvv/storyboard-reflection/

Halpern, N. (2008) Challenges in number sense development in early childhood. Retrieved from http://www.numbersmademeaningful.com/uploads/NMMresearchsupport.pdf.

Hansen, M. (2014).Helping children with autism learn with mathematics software. (Doctoral dissertation). Nova Southeastern University. GSCIS ETDs. Paper 3.Retrieved from http://nsuworks.nova.edu/cgi/viewcontent.cgi?article=1000&context=gscis_etd

Happe, F., & Frith, U. (2006). The weak coherence account: detail-focused cognitive Style in autism spectrum disorders. *Journal of Autism and Developmental Disorders*. DOI: 10.007/s10803-005-0039-0. Retrieved from http://www.ucp.pt/site/resources/documents/ICS/GNC/ArtigosGNC/AnaMariaAbreu/D_HaFr06.pdf

Hassan, A.Z.; Zahed, B.T., Zohora, F.T., Moosa, J.M., Salam, T., Rahman, M.M., Ferdous, H.S., Ahmed, S.I.(2011).Developing the concept of money by interactive computer games for autistic children. Multimedia .IEEE International Symposium .559,564, 5-7 doi: 10.1109/ISM.2011.99 Retrieved from http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6123407&isnumber=6123309

Helfin, J & Alaimo, D. F. (2007). Autism spectrum disorder: effective instructional strategies Upper Saddle River, NJ: Pearson Education Inc.

Hetzroni, O.E. & Tannous, J. (2004). A computer-based intervention program on the communicative functions of children with autism. *Journal of Autism and Developmental Disorders*, 34(2), 95-113.

Individuals With Disabilities Education Act, 20 U.S.C. § 1400 (2004).

Landa , R. (2000).Social language used in Asperger's syndrome.In

A.Klin.F.R.Volkmar,&S.S Sparrow (Eds.),*Asperger symdrome*.125-155.New York : Guilford Press.

Lane, A., Young, R., Baker, A., & Angley, M. (2010). Sensory processing subtypes in autism: association with adaptive behavior. *Journal Of Autism & Developmental Disorders*, 40(1), 112-122. doi:10.1007/s10803-009-0840-2

Lantz, J. (2002). Theory of mind in autism: Development, implications, and interventions. *The Reporter*, 7(3), 18-25. Retrieved from http://www.iidc.indiana.edu/?pageId=424

Learning Resource Management and Development System. Kindergarten weekly plan guide. Retrieved from http://lrmds.Department of Education.gov.ph/kinder

Libertus, M. E., & Brannon, E. M. (2009). Behavioral and neural basis of number sense in infancy. *Current Directions In Psychological Science (Wiley-Blackwell*), 18(6), 346-351. doi:10.1111/j.1467-8721.2009.01665.x

Luckevich, D. (2008). Computer assisted instruction for teaching vocabulary to a student with autism. Ph.D. dissertation, Nova Southeastern University, United States -- Florida. Retrieved June 8 , 2014, from Dissertations & Theses: A&I.(Publication No. AAT 3304124).

Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press

McKenzie, R., Evans, J., & Handley, S. (2010). Conditional reasoning in autism: activation and integration of knowledge and beliefs. *Developmental Psychology*, 46(2), 391-403.doi:10.1037/a017412

Mitchell, P. & Rajendran, G. (2007). Cognitive theories of autism. Retrieved from 214 https://wiki.inf.ed.ac.uk/twiki/pub/ECHOES/InteractiveTasks/RajendranMitchell2007.pdf.

Moore, M., & Calvert, S. (2000). Brief Report: Vocabulary acquisition for children with autism: Teacher or computer instruction. Journal of Autism and Developmental Disorders, 30, 359-362

Muda, Z. (2006). Storytelling approach in multimedia courseware: An introduction to science for preschool education. Information and communication technologies, 2006, 22991-2993. Retrieved from IEEE Xplore database.

Ontario Ministry of Education. (2007). Effective educational practices for students with autism spectrum disorder. A resource guide. Retrieved from http://www.edu.gov.on.ca/eng/general/elemsec/speced/asdsecond.pdf.

Osterling, J., & Dawson, G. (1994). Early recognition of children with autism: A study of first birthday home videotapes. Journal of Autism and Developmental Disorders, 24, 247–257. Retrieved from http://faculty.washington.edu/rab2/Site/AUT501_files/Osterling%26Dawson%201994.pdf

Picciano, A. (2004). Educational Research Primer. London: Continuum. Retrieved from http://www.mu.ac.in/myweb_test/Research%20Methadology-Paper-3/Chapter-5.pdf

Plaisted, K. C. (2001). Reduced generalization in autism: An alternative to weak central coherence. In J. A. Burack, T. Charman, N. Yirmiya, & P. R. Zelazo (Eds.), The development of autism: Perspectives from theory and research. New Jersey: Lawrence Erlbaum. 149-169

Ramdoss, S., Lang, R., Mulloy, A., Franco, J., O'Reilly, M., Didden, R., & Lancioni, G. (2011). Use of computer-based interventions to teach communication skills to children with autism spectrum disorders. *Journal Of Behavioral Education*, *20*(1), 55-76.

Resanen, P., Salminen, J., Wilson, A.J., Aunio, P. & Dehaene, S. (2009). Computer-assisted intervention for children with low numeracy skill. *Cognitve Development* 23(4): 450-472.

Rogers, S. J., & Ozonoff, S. (2005). Annotation: What do we know about sensory dysfunction in autism? A critical review of the empirical evidence. Journal of Student Psychology and Psychiatry,4 6, 1255–1268.Retrived from http://onlinelibrary.wiley.com/doi/10.1111/j.1469-7610.2005.01431.x/abstract

Rosely, M. (2007). Applying storytelling and gaming approach in multimedia application for preschool student. Retrieved from http://eprints.ptar.uitm.edu.my/1588/1/MOHAMMAD_SIDDIQ_ROSELY_07_24.pdf

Roslan R. (2011). Iqra' learning courseware.Retrieved from http://iportal.ump.edu.my/lib/item?id=chamo:67962&...

Sansosti, F. J., Powell-Smith, K. A., & Cowan, R. J. (2010). *High-functioning autism/Asperger syndrome in schools: Assessment and intervention*. New York: Guilford Press.

Savoie, M. (n.d.).Math motivation with smart board technology. report on the use of smart board interactive whiteboard to enhance math motivation in student with disabilities. Retrieved from http://downloads01.smarttech.com/media/sitecore/en/pdf/research_library/math/math_motivation_with_smart_board_technology.pdf.

Schiller, P. (n.d.). Early chilhood building blocks. making math meaningful and enjoyable. Retrieved from http://rec.ohiorc.org/orc_documents/orc/recv2/briefs/pdf/0010.pdf

Silver, M. & Oakes, P. (2001). Evaluation of a new computer intervention to teach people with autism or asperger syndrome to recognize and predict emotions in others. *Autism: The International Journal of Research and Practice, 5*(3), 299-316. Retrieved from http://www.editlib.org/p/94178/

Smith, S. (2009).Early childhood mathematics.(4th Ed.).United States of America ; Pearson Education Inc.

Strickland, D., Marcus, L. M., Mesibov, G. B., & Hogan, K. (1996). Brief report: Virtual reality as a learning tool for autistic studentren. Journal of Autism and Developmental Disabilities, 26, 651-659

Tomorszki, K. (2013). Recommended Use of ipad Games and Simulations for Autism remediation Retrieved from https://www.academia.edu/7687452/Recommended_Use_of_iPad_Games_and_Simulations_for_Autism_Remediation

Tucker. K.(n.d.). Teaching mathematics to children with autism.(Blogpost)Retrieved from http://www.udg.edu/tabid/14306/language/en-US/default.aspx

Veluz, M.(12, February 2015). Assistive and empathic technologies for autism.(Blog post). Retrieved from http://www.autismsocietyphilippines.org/2015/02/assistive-and-empathic-technologies-for.html

APPENDICES

APPENDIX A

Department of Education Order No. 72 s 2009 Inclusive Educationas a Strategy for Increasing Participation Rate of Students with Special Needs

JUL 0 6 2009

DepED O R D E R
No. 72 s. 2009

INCLUSIVE EDUCATION AS STRATEGY FOR INCREASING PARTICIPATION RATE OF CHILDREN

To: Undersecretaries
Assistant Secretaries
Bureau Directors
Regional Directors
Schools Division/City Superintendents

1. Special Education in the Philippines has only served 2% of the targeted 2.2 million children with disabilities in the country who live without access to a basic human right: the right to education. Most of these children live in rural and far flung areas whose parents need to be aware of educational opportunities that these children could avail of.

2. The Department of Education (DepED) has organized the urgency to address this problem and therefore, guarantees the right for these children to receive appropriate education within the regular or inclusive classroom setting. Inclusive education embraces the philosophy of accepting all children regardless of race, size, shape, color, ability or disability with support from school staff, students, parents and the community.

3. A comprehensive inclusive program for children with special needs has the following components:

a. **Child Find.** This is locating where these children are through the family mapping survey, advocacy campaigns and networking with local health workers. The children with special needs who are not in school shall be listed using Enclosure No. 1. These children shall be visited by Special Education (SPED) teachers and parents should be convinced to enroll their children in SPED Centers or schools nearest their home.

b. **Assessment.** This is the continuous process of identifying the strengths and weaknesses of the child through the use of formal and informal tools for proper program grade placement. Existing SPED Centers in the Division shall assist regular schools in the assessment process.

c. **Program Options.** Regular schools with or without trained SPED teachers shall be provided educational services to children with special needs. These schools shall access educational services from SPED Centers or SPED trained teachers.

The first program option that shall be organized for these children is a self-contained class for children with similar disabilities which can be mono-grade or multi-grade handled by a trained SPED teacher. The second option is inclusion or placement

of the child with disabilities in general education or regular class where he/she learns with his/her peers under a regular teacher and/or SPED trained teacher who addresses the child's needs. The third option is a resource room program where the child with disabilities shall be pulled out from the general education or regular class and shall report to a SPED teacher who provides small group/one-on-one instruction and/or appropriate interventions for these children.

d. **Curriculum Modifications.** This shall be implemented in the forms of adaptations and accommodations to foster optimum learning based on individual's needs and potentials. Modification in classroom instructions and activities is a process that involves new ways of thinking and developing teaching-learning practices. It also involves changes in any of the steps in the teaching-learning process. Curriculum modifications shall include service delivery options like cooperative or team teaching, consulting teacher program and others. The provision of support services from professionals and specialists, parents, volunteers, and peers or buddies to the children with special needs is an important feature in the inclusion program.

e. **Parental Involvement.** This plays a vital role in preparing the children in academic, moral and spiritual development. Parents shall involve themselves in observing children's performance, volunteering to work in the classroom as teacher aide and providing support to other parents.

4. District and school-based special education and regular teachers, administrators and parents need to collaboratively develop and facilitate the most effective program for children with disabilities. This program shall be included in the School Improvement Plan (SIP).

5. To realize the successful implementation of inclusive education in the schools, the duties and responsibilities of DepED officials are defined in Enclosure No. 2.

6. Officials at the division, region and central offices shall provide the needed training on inclusive education to administrators, teachers and other school staff; regularly monitor the implementation of the program and provide the corresponding technical assistance needed and conduct evaluation to determine the effectiveness of the program and improve its implementation.

7. Immediate dissemination of and compliance with this Order is directed.

APPENDIX B

Profile of the Evaluators of Power Point Version of the Courseware

Evaluator	Sex	Position	Institution
1	F	Education Program Supervisor I	Department of Education
2	F	Principal III/ School Special Education Coordinator	Department of Education
3	F	Principal II/ School Special Education Coordinator	Department of Education
4	F	Principal I/ School Special Education Coordinator	Department of Education
5	F	Early Intervention Program Manager	Children's Developmental Intervention Center of Lipa

APPENDIX C

Profile of the Evaluators of Pre –Mathematics Skills

Evaluator	Sex	Position	Years of teaching experience handing students with autism	Educational Background
1	F	Special Education Teacher I	4	Bachelor's Degree with Masteral Units
2	F	Special Education Teacher I	5	Master's Degree w/ Doctoral units
3	M	Special Education Teacher III	6	Master's Degree w/ Doctoral Units
4	F	Early Intervention Program Teacher	3	Bachelor's Degree with Masteral Units
5	F	Intervention Program Teacher	3	Bachelor's Degree with Masteral Units

APPENDIX D

Profile of the Evaluators of Technical Quality

Evaluator	Sex	Institution	Educational Background
1	M	De La Salle University - Lipa	Masters in Information Technology (MIT)
2	M	De La Salle University - Lipa	Masters in Information Technology (MIT)
3	F	De La Salle University - Lipa	Masters in Information Technology (MIT)
4	M	Systems Technology Institute (STI) College.	Masters in Information Technology (MIT)
5	F	Systems technology institute (STI) College.	Masters in Information Technology (MIT)

APPENDIX E

Profile of the Validators of Instrument

Evaluator	Sex	Position	Educational Background	Institution
1	F	College Professor	Master's Degree	De La Salle University - Lipa
2	F	College Professor	Master's Degree	De La Salle University - Lipa
3	M	College Professor	Master's Degree	De La Salle University - Lipa
4	F	College Professor	Master's Degree with Doctoral Units	De La Salle University - Lipa
5	F	College Pychometrician	Master's Degree with Doctoral Units	De La Salle University - Lipa

APPENDIX F

Needs Assessment Form

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

To the respondents,

The undersigned is graduate student of the Philippine Normal University who is currently taking up Masters of Education with specialization in Special Education.

I am conducting a study entitled "Development a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism". The study aims to develop a multimedia courseware that will serve as an aid in teaching pre – mathematics skills for kindergarten pupils with autism.

This would be of great help for the undersigned to complete his endeavor. Thank you

_____
Mr. Ervin Salupare
Researcher

Name: (optional) _____ **School:** _____
Gender: □ Male □ Female

Years of teaching experience in handling Pupils with autism _____

Part I . Identification of Learning Competencies

Below are including in the Curricular Framework for Kindergarten Pupils with Autism Pre –Mathematics Skills Section . Recall the experiences you had in teaching pre-mathematics skills of pupils with autism. And based on your experience, Gauge the items by checking the description of the work that pupils with autism may require in learning the given competencies / concepts. Rate it with

1- Very difficult **2- Difficult** **3- Easy** **4- Very easy**

Learning Competencies	**1**	**2**	**3**	**4**
1. Arranging objects in the order of size from smallest to largest				
2. Selecting long, longer, longest from group of objects				
3. Selects short, shorter, shortest from group of Objects				
4. Locating front and back, left and right				
5. Pointing first, middle and last in group of objects				
6. Naming coins: one, two, five, ten, twenty five, etc				
7. Constructing sets of one, two, three, four and five objects, etc.				
8. Counting from 1 to 10 orally and perfectly				

Part II : Design Consideration for the Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism.

Rate the following design criteria based on its significance in the design of a pre-mathematics skills multimedia courseware for kindergarten pupils with autism.

1 – Not at all important 2 – Least importance 3 – Moderately important 4 – Very important

Criteria	**1**	**2**	**3**	**4**
Instructional Content				
1. Contents should be accurate, complete and current .(Coherence Principle)				
2. All the courseware contents should be related to the stated purpose/objective.				
3. Instructional content delivery should be suited for pupils with autism.				
Layout				
4. Layout should make it easy for the pupils to process graphics and text. (Sensory Processing Difficulties Theory)				
5. Layout should be consistent in all parts. (Coherence Principle)				
6. Layout should be clear .(Sensory Processing Difficulties Theory)				
7. Layout should be logical (Coherence Principle).				
8. Titles and subtitles should be clearly defined. (Sensory Processing Difficulties Theory)				
Accessibility				
9. The courseware should accommodate the unique learning style of Pupils with autism. (Weak Central Coherence Theory)				
10. The courseware should be used by the pupils without much help from the teacher.				
11. The courseware should be accessible in any type of computer.				
Age /Grade Level Appropriateness				
12. Reading level should be appropriate for Pupils with autism.				
13. Product should be suitable for the age and grade level of pupils with autism				
14. Directions are clear and complete enough for pupils to perform required tasks (Segmentation Principle)				
Learner Engagement/ Interactivity				
15. The courseware should encourage become engaged and motivated				
16. The courseware should employ multimedia				

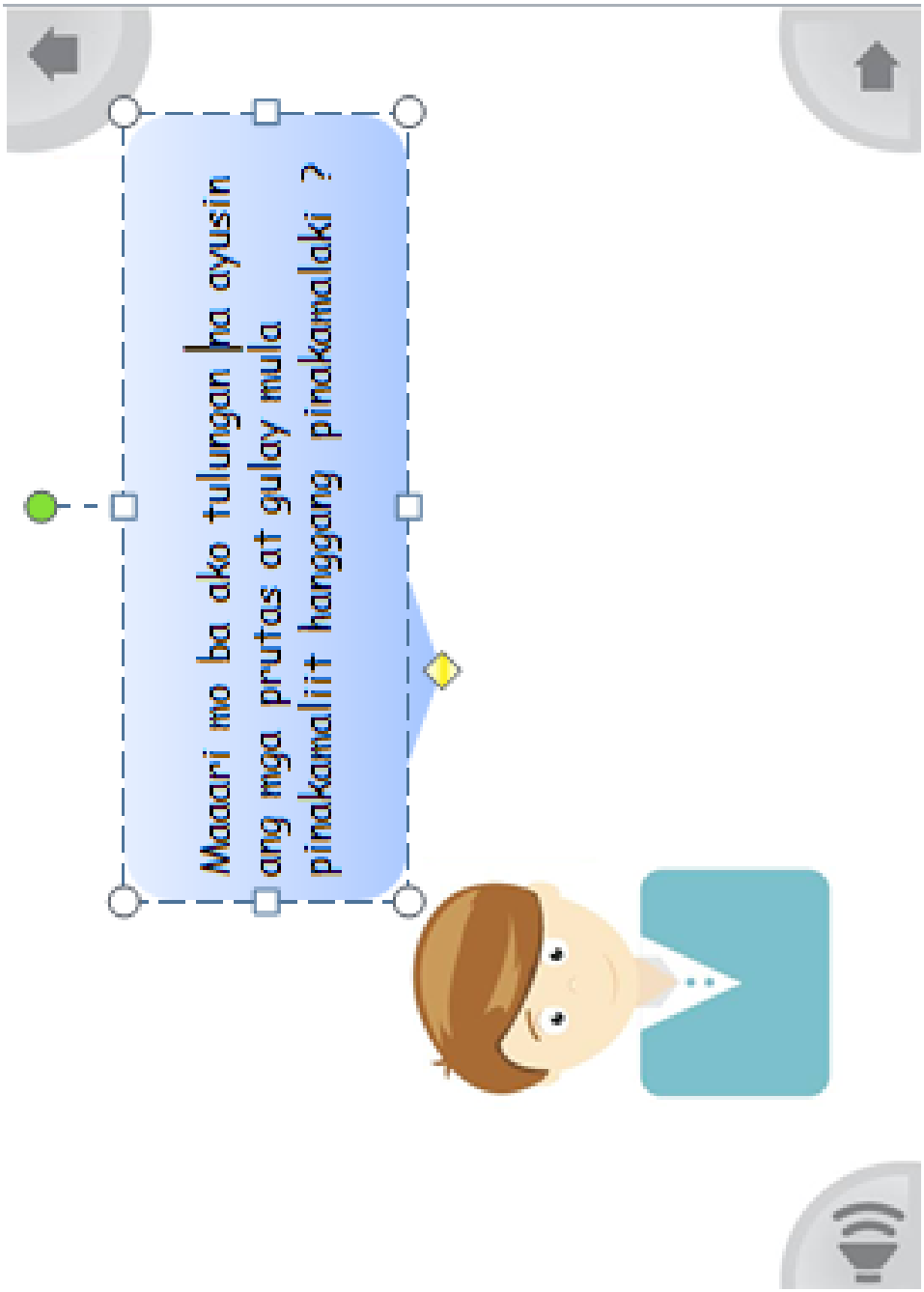
enhancements principles to make learning interactive .(Multimedia Principle)				
17. Appropriate and encouraging feedbacks should be provided throughout the instruction. (Voice Principle and Personalization Principle).				
18. Feedback should enable pupils with autism to recognize error commission. (Impaired Theory of Mind Theory)				
Assessment				
19. Assessment procedures should be appropriate and suited.				
20. Teachers should easily assess pupils ' progress by evaluating the outcomes provided within the product.				
Technical Quality				
21. All links should be working properly.				
22. The sounds should be aligned to the lessons / activities.				
23. The use of images should be aligned to the lessons / activities.				
24. All multimedia assets should work at all times.				
Graphics /Multimedia				
25. Background and text should be pleasing, compatible and easy to read.				
26. Graphics should be appropriately designed to optimize learning of pre –mathematics skills.(Multimedia Principle)				
27. Graphics and animations should catch the interest of pupils with autism.				
28. Multimedia elements should be capable of being adjusted.(Sensory Processing Difficulties Theory)				

Please specify additional considerations or features you would want to see in the courseware.

_____

APPENDIX G

SAMPLE POWERPOINT VERSION OF THE COURSEWARE


Maaari mo ba ako tulungan na ayusin
ang mga prutas at gulay mula
pinakamaliit hanggang pinakamalaki ?

Ayusin mula pinakamaliit hanggang pinakamalaki.

Ayusin mula pinakamaliit hanggang pinakamalaki.

Binabati Kita !
Natapos mo na
ang gawain !

APPENDIX H

Power Point Version Content Validation Form

Name: (Optional)

Position:

Following are questions concerning the content of the Power Point version of the courseware. Kindly answer the questions by putting a check √ mark on the appropriate column.

Questionnaires	Yes	No	Comments/Suggestions
1. Are the items anchored on the Curricular Framework for Kindergarten Autism?			
2. Are the test items aligned with the target competency?			
3. Are the items developmentally sequenced to suit the needs of students with autism?			
4. Is the vocabulary used appropriate to the level of understanding of pupils with autism?			
5. Is the difficulty level aligned with intended use?			
6. Are the item's prompts and tasks aligned?			
7. Are the items able to produce the cognitive processes intended?			
8. Is there a need to modify certain parts of the test? Please specify.			

APPENDIX I

Preliminary Try out Observation Form

Name: (Optional) _____ Age: ____
Gender: □ Male □ Female

Following are the competencies included in the Power Point version of the multimedia courseware on pre- mathematics skills . The researcher is going to assess of the following competencies based on how the student perform on the Power Point version of the courseware

I. Competencies
1. Arranging objects in the order of size from smallest to largest
2. Selecting long, longer, longest from group of objects
3. Selecting short, shorter, shortest from group of objects
4. Locating front and back, left and right
5. Pointing first, middle and last in group of objects
6. Naming coins: one, two, five, ten, twenty five, etc
7. Constructing sets of one, two, three, four and five objects, etc.
8. Counting from 1 to 10 orally and perfectly

II. Behavior Characteristics	**Yes**	**No**
1. The pupil demonstrated need for sameness and predictability		
2. The pupil demonstrated sensory processing needs (over or under stimulation to sensory stimuli)		
3. The pupil demonstrated with manual dexterity fatigue and weak grasp		
4. The pupil demonstrated prompt dependence		
5. The pupil was frustrated with error commission while working		
6. The pupil demonstrated detail focus and good visual processing		
7. The pupil had difficulty recognizing right and wrong		

What are the other behaviors observed in the student while using the Power Point version ?
_____

APPENDIX J

Computer Literacy Checklist

Name (optional): _____ Gender: □ Male □ Female Age: ____

Literacy Checklist

The following statements describe the computer literacy skills of pupils with autism. Based on your observation, rate the ability of the pupil on how he /she performs the following skills by writing a (√) mark

"Yes" if the pupil can perform the skill independently
"No" if the skills has not yet been introduced

You can also indicate the degree of assistance needed from minimal, moderate to maximal.

Computer Literacy	**Yes**	**No**	**Degree of Assistance**
1. Can navigate the pointer by touching the screen and make it go where he wants it to?			
2. Can click an icon or item on the screen by tapping the screen?			
3. Can drag an item by using his fingers			
4. Can use scroll by swiping the screen ?			
5. Can start a program by tapping the screen?			
6. Can play or use an educational software program or game when given a sequence of steps to follow?			
7. Can use menus and options by tapping the screen? (e.g. saving or exiting)			

APPENDIX K

Multimedia Courseware Evaluation Form

Content Quality

Name (Optional):

Date of Evaluation:

Title of the Program:

Subject Area / Domain :

Direction : The following items pertain to the developed multimedia courseware on pre-mathematics skills for kindergarten pupils with autism . Kindly put a check (√)under the number of your corresponding response to each criterion below.

Descriptive Rating	Rating
Excellent	4
Very Satisfactory	3
Satisfactory	2
Unsatisfactory	1

Criteria				
	1	**2**	**3**	**4**
Instructional Content				
1. Contents were accurate, complete and current. (Coherence Principle)				
2. All the courseware contents were the stated purpose/objective.				
3. Instructional content delivery was suited for pupils with autism.				
Layout				
4. Layout made it easy for the pupils to process graphics and text. (Sensory Processing Difficulties Theory)				
5. Layout was consistent in all parts. (Coherence Principle)				
6. Layout was clear (Sensory Processing Difficulties Theory)				
7. Layout was logical. (Coherence Principle				

(Sensory Processing Difficulties Theory))				
8. Titles and subtitles were clearly defined.				
Accessibility				
9. The courseware accommodated the unique learning style of pupils with autism. (Weak Central Coherence Theor)				
10. The courseware could be used by the pupils without much help from the teacher.				
11. The courseware was accessible in any type of computer.				
Age / Grade Level Appropriateness				
12. Reading level was appropriate for pupils with autism.				
13. Product was suitable for the age and grade level of pupils with autism. 14. Directions are clear and complete enough for pupils to perform required tasks.(Segmentation Principle)				
Learner Engagement/ Interactivity				
15. The courseware could encourage pupils become engaged and motivated.				
16. The courseware should employ multimedia enhancements principles to make learning interactive(Multimedia Principle)				
17. Appropriate and encouraging feedbacks were provided throughout the instruction.				
18. Feedback should enabled pupils with autism to recognize error commission.(Voice and Personalization Principle)				
Assessment				
19. Assessment procedures were appropriate and suited.				
20. Teachers could assess pupils ' progress by evaluating the outcomes provided within the product.				

What suggestions could you give to improve the multimedia courseware?

_____

Multimedia Courseware Evaluation Form

Technical Quality

Name (Optional):

Date of Evaluation:

Title of the Program:

Subject Area / Domain:

Direction: The following items pertain to the developed multimedia courseware on pre-mathematics for kindergarten pupils with autism. Kindly put a check (√) under the number of your corresponding response to each criterion below.

Descriptive Rating	**Pre-mathematics Rating**
Excellent	4
Very Satisfactory	3
Satisfactory	2
Unsatisfactory	1

Criteria				
Technical Aspects				
1. All links were working properly.				
2. The sounds were aligned to the lessons / activities.				
3. The use of images was aligned to the lessons / activities.				
4. All multimedia assets worked at all times.				
Graphics / Multimedia				
5. Background and text were pleasing, compatible and easy to read.				
6. Graphics were appropriately designed to optimize learning of pre –mathematics skills (Multimedia Principle).				
7. Graphics and animations could catch the interest of pupils with autism.				
8. Multimedia elements were capable of being adjusted.				

What suggestions could you give to improve the courseware?

APPENDIX L

Try -Out Evaluation Form

Name (Optional): _____ **Date: _____**

Based on the observation made on the pupil while using the courseware, put a check (√) under the number of your corresponding response.

Response Option

Strongly Agree - 4

Agree - 3

Disagree -2

Strongly Disagree -1

Criteria	4	3	2	1
1. The pupil usually behaved appropriately while using the courseware.				
2. The pupil appeared wanting to start using the courseware				
3. The pupil appeared to enjoy using the courseware.				
4. The pupil appeared to understand how to use the courseware.				
5. The pupil seemed to like the rewards in the courseware.				
6. The pupil was seen initiating the tasks in the courseware				
7. The pupil is seen to navigate with ease through the program sequence.				
8. The pupil seemed to be able to follow the instruction of the program with ease. (number of computer prompts in instruction-related tasks)				
9. The pupil is seen to be able to focus on the task given by the courseware by paying attention to the details of the task.				
10. Cues and prompter help pupils to do the given instruction.				

What are the other behaviors observed in the pupil while using the courseware

APPENDIX M

Letter of Request for Needs Assessment

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

Schools Division Superintendent
Department of Education Schools Division of Lipa

Greetings of Peace!

The undersigned is graduate pupil of the Philippine Normal University who is currently taking up Masters of Education with specialization in Special Education. pursuing a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism". The study aims to develop a multimedia courseware that will serve as an aid in teaching pre –mathematics skills for kindergarten pupils with autism.

In line with this study, the researcher respectfully seeks your approval in distributing and accomplishing the needs assessment form for validity purposes .The researcher will ask assistance of the Special Education teachers handling pupils with autism. Specifically the Special Education teachers will fill in the needs assessment form containing (1) the learning competencies (2) design consideration for the pre –mathematics skills multimedia courseware for kindergarten pupils with autism and (3) Administer the Power Point version of the courseware to qualified participant on the kindergarten level of pupils with autism.

Your kindness will surely pave way for the researcher's betterment as an educator.
Herewith are the above mentioned research instruments for your reference.

Hoping your understanding and approval regarding this matter

Thank you.

Respectfully, Noted:

ERVIN SALUPARE	**DR. FORTUNATO VENDIVEL JR.**	**PROF. EMILIO AGUINALDO**
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX N

Letter of Permission to Conduct the Study

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

MS. LOURDES E. DE JESUS
Principal III
Sen.. Claro M. Recto Memorial School –Lipa City Special Education Center
Lipa City

Madam :

Greetings!

The undersigned is a undersigned is graduate pupil of the Philippine Normal University who is currently taking up Masters of Education with specialization in Special Education pursuing a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism". The study aims to develop a multimedia courseware that will serve as an aid in teaching pre- math skills for kindergarten pupils with autism.

In line with, may I request your permission to utilize the kindergarten pupils with autism as participants of my study and Special Education Teachers who have experiences handling pupils with autism to be evaluators of the multimedia courseware .

Thank you very much..

Respectfully, Noted:

_____	_____	_____
ERVIN SALUPARE	**DR. FORTUNATO VENDIVEL JR.**	**PROF. EMILIO AGUINALDO**
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX O

Request for Instrument Validation

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

Date:

College Professor /College Pychomterician

Dear /Sir Madam,

Greetings!

The undersigned is a undersigned is graduate pupil of the Philippine Normal University who is currently taking up Masters of Education with specialization in Special Education pursuing a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism". The study aims to develop a multimedia courseware that will serve as an aid in teaching pre -math skills for kindergarten pupils with autism.

In recognition of your expertise in instrument validation, the I am humbly requesting you be one of the experts who will validate my research instruments. Upon your approval , may I know your most convenient time to have a panel meeting? This is to further discuss matter regarding the instrument validation .

Thank you so much for allowing yourself to be part of this research..

Thank you very much..

Respectfully, Noted:

ERVIN SALUPARE	**DR. FORTUNATO VENDIVEL JR.**	**PROF. EMILIO AGUINALDO**
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX P

Request Letter for the Special Education Teachers / Content Experts

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

Date:

Special Education Teacher
PupilsDevelopment Intervention Center of Lipa

Dear /Sir Madam,

Greetings!

The undersigned is presently in the process of conducting a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism ".The study aims to develop a multimedia courseware that will serve as an aid in teaching pre- math skills for kindergarten pupils with autism.

In recognition of your expertise and having been taught Special Education for several years, the researcher believes that you can provide relevant comments, opinions and suggestions to improve the developed multimedia instructional materials. May I request that you view the PowerPoint of the courseware and help evaluate it by giving your opinion. Attached herewith is the copy of the evaluation form.

Thank you so much for allowing yourself to be part of this research.

Respectfully, Noted:

ERVIN SALUPARE	DR. FORTUNATO VENDIVEL JR.	PROF. EMILIO AGUINALDO
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX Q

Request Letter for the Information Technology Experts

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

Date :

College Professors/IT Expert

Dear Sir /Madam ,

Greetings!

The undersigned is presently in the process of conducting a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism ".The study aims to develop a multimedia courseware that will serve as an aid in teaching pre- math skills for kindergarten pupils with autism.

In recognition of your expertise and having been taught Special Education for several years, the researcher believes that you can provide relevant comments, opinions and suggestions to improve the developed multimedia instructional materials. May I request that you view the multimedia courseware and help evaluate its technical quality it by giving your opinion. Attached herewith is the copy of the evaluation form.

Thank you so much for allowing yourself to be part of this research.

Respectfully, Noted:

_____	_____	_____
ERVIN SALUPARE	DR. FORTUNATO VENDIVEL JR.	PROF. EMILIO AGUINALDO
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX R

Request Letter to the Content Evaluator

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

Date :

College Professor
_____

Dear Sir ,

Greetings!

The undersigned is presently in the process of conducting a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism .The study aims to develop a multimedia courseware that will serve as an aid in teaching pre -math skills for kindergarten pupils with autism.

In recognition of your expertise and having been taught Special Education for several years, the researcher believes that you can provide relevant comments, opinions and suggestions to improve the developed multimedia instructional materials. May I request that you view the multimedia courseware and help evaluate its content quality by giving your opinion. Attached herewith is the copy of the evaluation form .

Thank you so much for allowing yourself to be part of this research.

Respectfully, Noted:

_____	_____	_____
ERVIN SALUPARE	DR. FORTUNATO VENDIVEL JR.	PROF. EMILIO AGUINALDO
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX S

Parental Consent

Philippine Normal University
National Center for Teacher Education
Taft Avenue Manila

Date :

Dear Parents,

The undersigned is presently in the process of conducting a research study entitled "Development of a Multimedia Courseware on Pre –Mathematics Skills for Kindergarten Pupils with Autism ".The study aims to develop a multimedia courseware that will serve as an aid in teaching pre -math skills for kindergarten pupils with autism.

.
In line with this, I am asking for your permission to allow your pupil to participate in this study as he will accomplish the Power Point version of the courseware. Furthermore another administration will be done after the courseware's development. Your pupil's participation will be instrumental in the finalization of the multimedia courseware

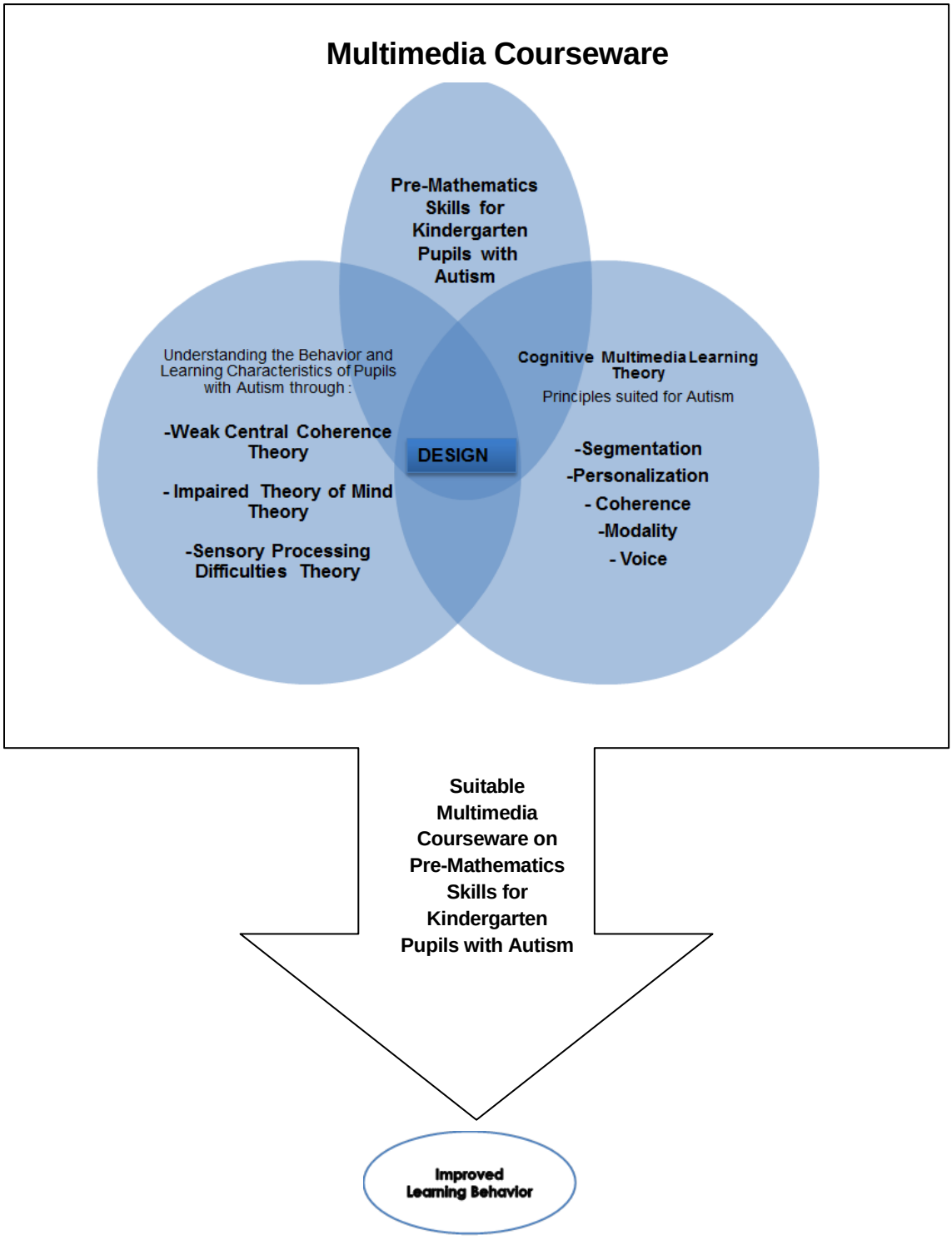
Rest assured that all personal information obtained about your about your pupil will be treated utmost confidentiality. Thank you for your support.

Respectfully, Noted:

_____	_____	_____
ERVIN SALUPARE	DR. FORTUNATO VENDIVEL JR.	PROF. EMILIO AGUINALDO
Researcher	Thesis Adviser	Thesis Adviser

APPENDIX T

SAMPLE OF THE MULTIMEDIA COURSEWARE ON PRE-MATHEMATICS SKILLS FOR KINDERGARTEN PUPILS WITH AUTISM



Theoretical Framework


Kaliwa, Kanan, Harapan, Likuran
Unahan, Gitna, Hulihan
Pinakamaliit Hanggang Pinakamalaki
Ang
Pamilihan Ni
ERVIN
Maikli, Mas Maikli, Pinakamaikli
Mahaba, Mas Mahaba Pinakamahaba
Pagbilang
Barya
Kabuuang Bilang
Piliin ang Kulay ng Bakgrawnd

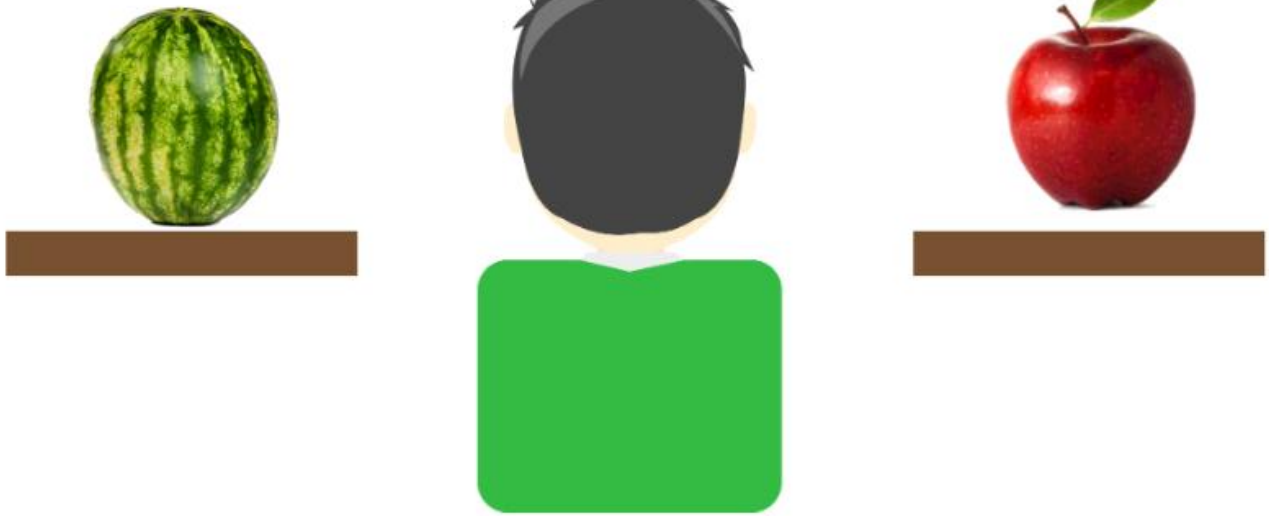
Ang Pamilihan Ni ERVIN

Maaari mo ba akong tulungang piliin ang prutas at gulay ayon sa posisyon nito?


Ang Pamilihan Ni ERVIN
Ang Pamilihan Ni ERVINN
Halimbawa

Ang Pamilihan Ni ERVIN

Pindutin ang nasa kaliwa.

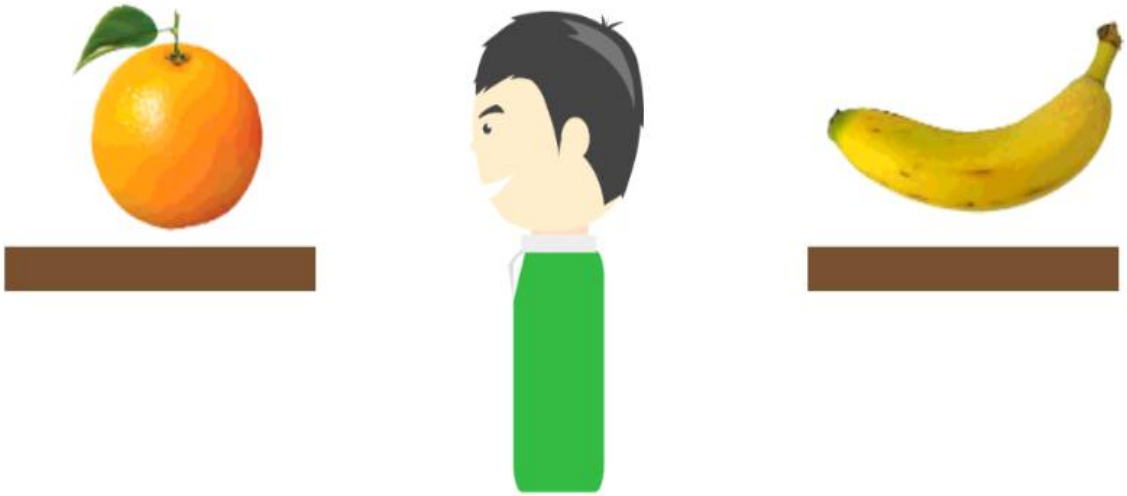


Ang Pamilihan Ni ERVIN

Pindutin ang nasa likuran.

Ang Pamilihan Ni ERVIN

Pindutin ang nasa harapan.

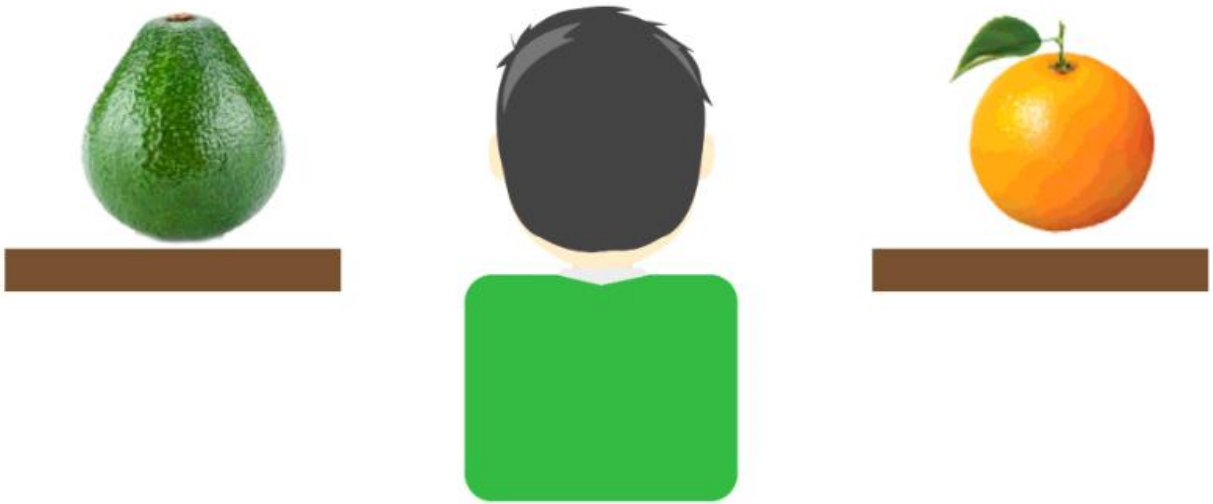


Ang Pamilihan Ni Ni ERVININ

Pindutin ang nasa kaliwa.

Ang Pamilihan Ni ERVIN

Pindutin ang nasa kanan.

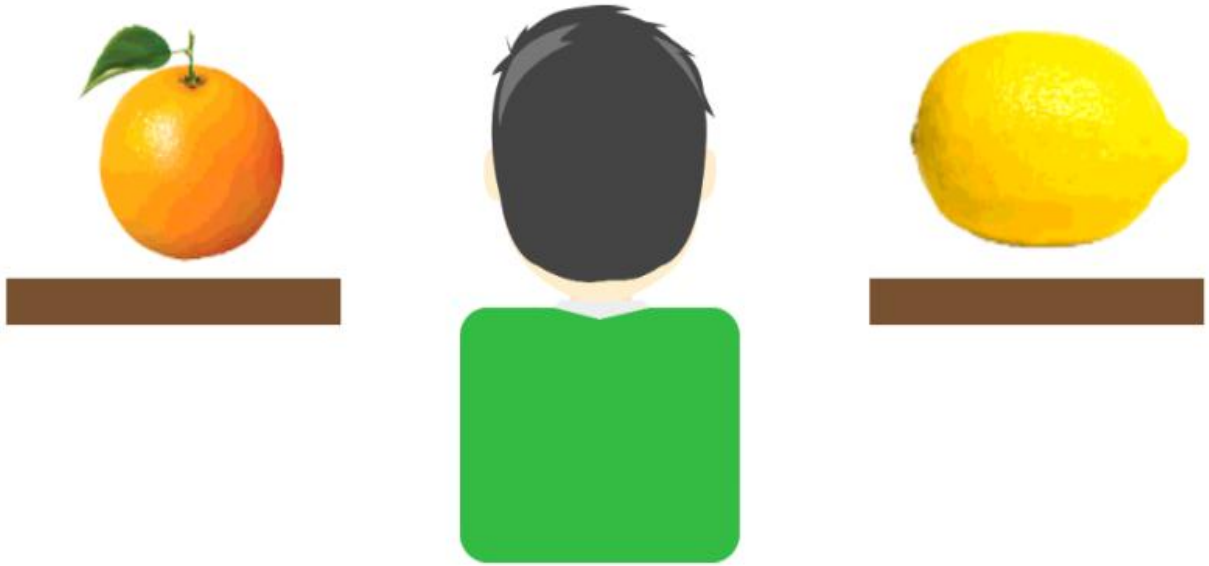


Ang Pamilihan Ni ERVIN

Pindutin ang nasa kaliwa.

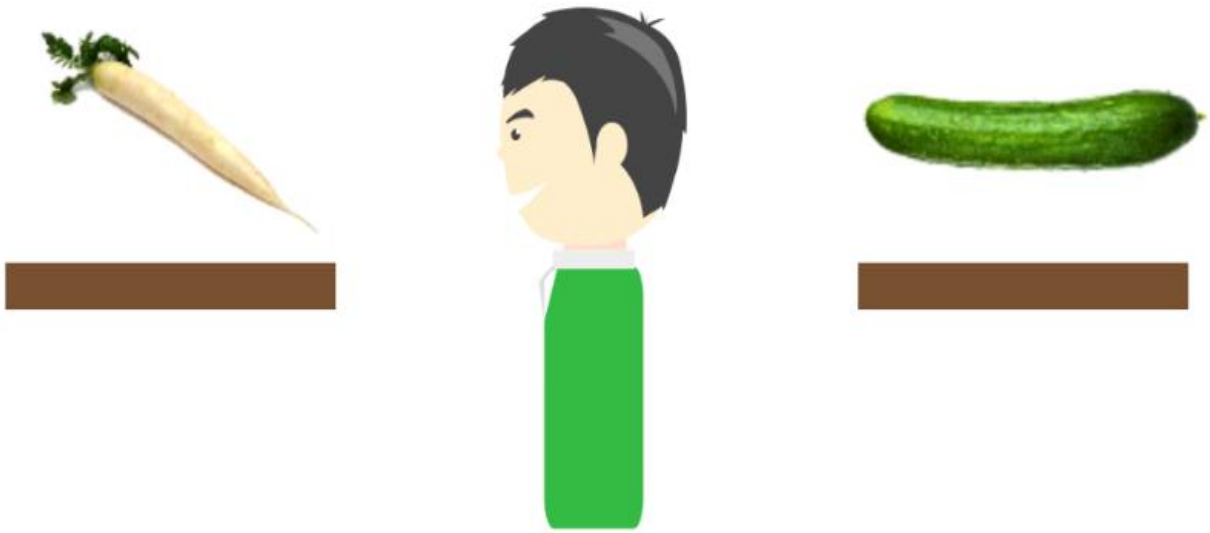
Ang Pamilihan Ni ERVIN

Pindutin ang nasa kanan.



Ang Pamilihan Ni ERVIN

Pindutin ang nasa likuran.

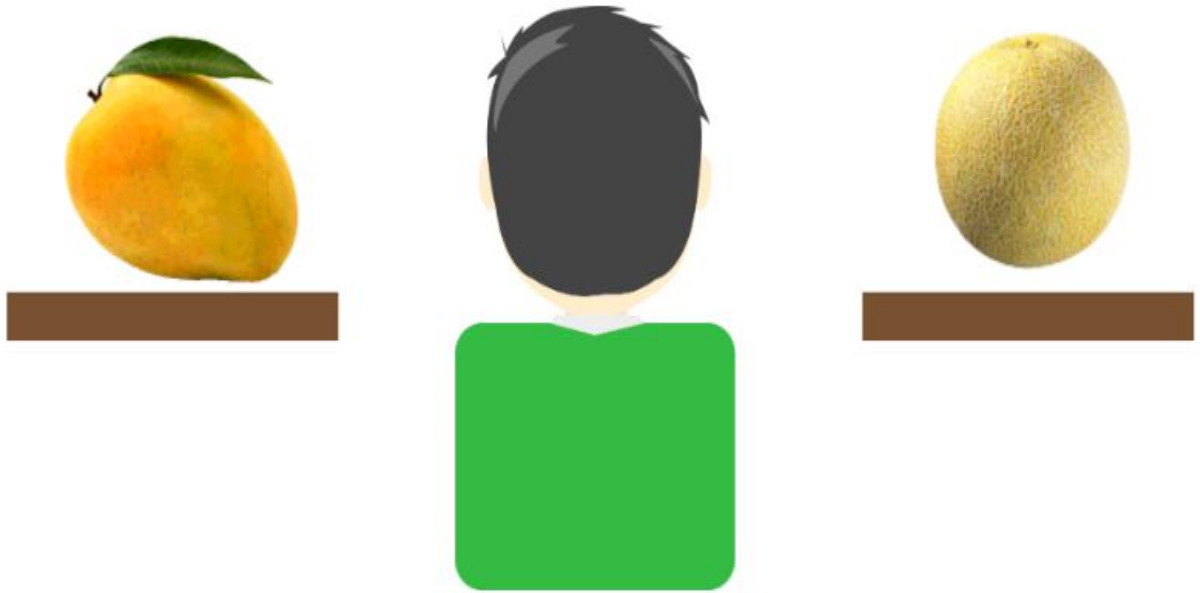


Ang Pamilihan Ni Ervin

Pindutin ang nasa harapan.

Ang Pamilihan Ni ERVIN

Pindutin ang nasa kaliwa.




Ang Pamilihan Ni
ERVIN
Binabati Kita!
Natapos mo na
ang gawain!

Ang Pamilihan Ni ERVIN

Ito ang iyong Iskor :

APPENDIX U

USER‘S MANUAL

Table of Contents

Introduction

Multimedia Courseware on Pre Mathematics

Courseware refers to an educational material kit for teachers or trainers for students, commonly parceled for use with a computer (Veluz, 2015) However, though there is need for this approach in the education of pupils with autism, certain concerns were noted. According to Chong and Putnam, (2002) despite the availability of the said technology, few have access to it due to its complexity and high purchase price. They also asserted that technologies presently being used for autism had limited considered autism's unique characteristics. Furthermore, these technologies were designed for the typical users.

Similarly, in the Philippines, the above mentioned concerns were also true. Most of the technologies, including courseware available in the market are intended for typical pupils who have the normal learning ability. Veluz (2015) stressed why technology has an increasingly essential role in helping Filipinos with autism to live purposeful lives. Children at an early age today are much inclined to technology. Modification in the classroom instructions and activities is a process that involves new ways of thinking and developing teaching and learning practices.

This multimedia courseware was developed to contribute in the education of pupils with autism specifically, aid in learning of pre-mathematics skills since limited technologies were designed and made specifically for them. Pupils with autism can attain good work behaviors while learning the pre-mathematics skills since the design features had carefully considered the way they think, behave and process information.

Lesson Guide

The concepts included in the multimedia courseware were all the pre-mathematics competencies the lifted from the Curricular Framework for Kindergarten Pupils with Autism (2012) by the Department of Education. The lessons specified could be integrated andused as supplementary material for pre- assessment and assessment part of the teaching process .

The section below presents each lesson's objective and activity

Lesson 1 : **PinakamaliitHanggangPinakamalaki**

Objective: Selects long, longer, longest from the group of fruits and vegetables

Activity: Dragging the fruits and vegetable in the order of size from smallest to largest

Lesson 2 : **Mahaba, Mas Mahaba**. **Pinakamahaba**

Objective: Selects long, longer, longest from the group of fruits and vegetables

Activity: Tapping /Clicking long, longer, longest from the group of fruits and vegetables

Lesson 3: **Maikli, Mas Maikli, Pinakamaikli.**

Objective: Selects short , shorter, shortest from the group of fruits and vegetables

Activity: Tapping /Clicking short, shorter , shortest from the group of fruits and vegetables

Lesson 4: **Unahan, Gitna, Hulihan.**

Objective: Locates first, middle and last in the group of fruits and vegetables

Activity: Tapping /Clicking first, middle and last in the group of fruits and vegetables

Lesson 5: **Kaliwa, Kanan, HarapanLikuran.**

Objective: Locates which fruit or vegetable faces front and back, left or right

Activity: Tapping /Clicking which fruit or vegetable faces front and back, left or right of the narrator

Lesson 6: **Barya**

Objective: Identifies coins: one, five, ten, twenty five, etc

Activity: Tapping /Clicking the coins: one, two, five, ten, twenty and five

Lesson 7: **KabuuangBilang**.

Objective: Constructs sets of one, two, and three up to ten fruits or vegetables

Activity: Dragging thefruits or vegetables into the basket to construct sets of one, two, and three up to ten .

Lesson 8: **Pagbilang**

Objective: Counting orally from 1 to 10 by tapping the center of the tree.

Activity: Counting orally from 1 to 10 by tapping the center of the tree.

Parts and Features of the Multimedia Courseware

Main Menu

This part contains the title courseware, its home screen. It contains all the mini games selection panel based on the adapted pre – mathematics curriculum for kindergarten pupils with autism . It also contains the multimedia options for background change, sound and music adjustment and narration and picture mode option.

Narration and Picture Mode

This feature lets the user select whether he / she prefers that all the text on the mini games be removed leaving only pictures and narration during play

Background Change Option 

This feature lets the user select the background color he / she prefers before playing.

Music Option 

This feature provides control whether music will be played. The adjustment music is provided externally on the device.

Audio Option 

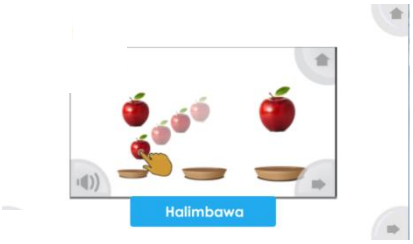
This feature provides control whether the overall sound will be played or not. The music adjustment is provided externally on the devic

Mini Game 

This part includes the courseware game proper for specific competencies that were mentioned earlier. Each mini game has the following parts;

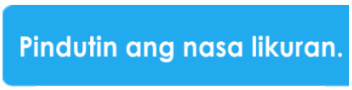
Maaari mo ba…. 

Each mini game starts with the appearance of a motive question politely asking the user to play the game and help accomplish the activity specific to the mini game selected .

Halimbawa 

(Sample Only)

This provides the user with a tutorial screen of the task specific to each mini game.

Instruction 

(Sample Only)

This specifies the task to be donein particular mini game. This is written and narrated in short and simple way.

BinabatiKita !Nataposmonaang Gawain!

This part signifies that the user has finished the mini game .

Ito ang iyong Iskor.

This part gives a simple scoring information.

NOTE: Since the scoring part is automated, a prompt guide is provided for a more detailed monitoring of performance. Write the number of items and the prompt required below the bulb. A sheet is provided for printing in the installation disc .

Legend	Description
V for Verbal	Repeating instructions verbally and telling pupil what to do
G for Gesture	Pointing, indicating the physical movement you want the pupil
M for Model	Showing the pupil what you want him/her to do without physically touching him/her
P for Physical	Guiding the pupil physically what to do(e.g hand over hand assistance)

Source: *Prompting Hierarchies retrieved* from http://www.dspcoop.k12.in.us/Teacher%20Training_files/prompting%20hierarchies.pdf

Narrator 

This feature provides friendly audio narrations as the user navigates through the courseware . Narrations are provided on the courseware title, motive question, instruction, feedback, end scene and competency assessment

Emoticon

This feature provides the visual cue whether an answer is right or wrong. The happy face is color red while sad face is color yellow.

Hint 

(Sample Only)

This provides a bulb visual cue that leads to the correct answer. This activates after three consecutive mistakes committed by the user.

Multimedia Functions Guide

This document contains all essential information for the user to make full use of the multimedia courseware. This manual includes a description of the system functions and capabilities and step-by-step procedures for system access and use.

A. SYSTEM REQUIREMENTS

- Android: OS 2.3.1 or later; ARMv7 (Cortex) CPU or Atom CPU; OpenGL ES 2.0 or earlier.
- Window Desktop/ Laptop: OS: Windows XP+ ,Graphics card: DX9 (shader model 2.0) capabilities

Figure 1: Main Menu (Mini Game Selection**)**

Figure 1 shows the Mini Game Selection with its main multimedia options and buttons.

B. THE *HOW TO'S* OF THE MULTIMEDIA FEATURES /OPTIONS

On the bottom left side of the main menu, there is an **Audio Option** represented by a volume icon which is used to change sound level (volume). Using the audio button, the user can control whether the overall sound will be played or not by clicking or tapping as shown in Figure 2.

On Off

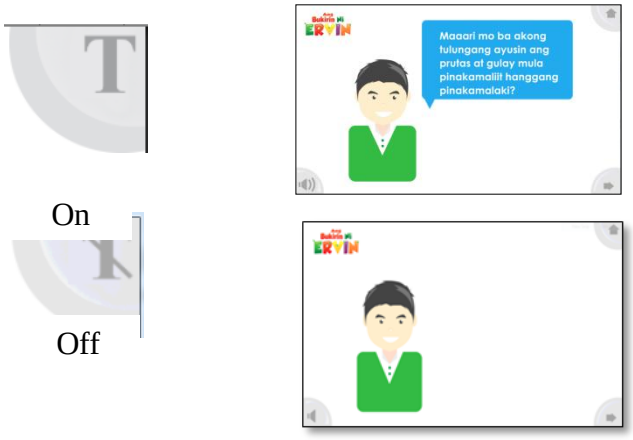
Figure2:Audio Button (on /off)

On the bottom right side of the main menu, there is **Music Option** represented by note icon which provides control whether music will be played or not. Using the music button, the user can control the music will be played or not by clicking or tapping as shown in Figure 3.

On Off

Figure 3: Music Button (on/off)

On the upper right side of the main menu, there is the**Narration and Picture Mode** represented by an image of a "T" .This lets the user select whether he / she prefer that all the text on the mini games be removed, leaving only pictures and narration before playing as shown in Figure 4.



On

Off

Figure 4: Narration and Picture Mode (on/ off)

The Mini Game Button/ Icon

The user can select the game he/ she wants to play from the Mini Game Selection by clicking/tapping the button/icon.

Figure 5 is a sample of a mini game button/icon from the list.

Figure 5: Sample Mini Game Button/Icon

In the example shown, the Mini Game button was for **Kaliwa, Kanan, Harapan, Likuran.** The title shown was exclusive for this mini game.

On the bottom middle of the Main Menu shown in **Figure 6,** there is the **Background Change Option** represented by three circles with different colors**.** The user selects the background color before playing.by clicking /tapping the circle. Default color is White .

Figure 6: Background Change Button

C. THE GAME PROPER

As shown in Figure 7, the Mini Game Navigational Options in the each mini game starts with the appearance of a **Motive Question** politely asking the user to play the game and help accomplish the activity specific to the mini game selected. The user has the option of playing the game by clicking/tapping the **next button** or moving back the main menu by clicking/tapping on the **back/ home** button.

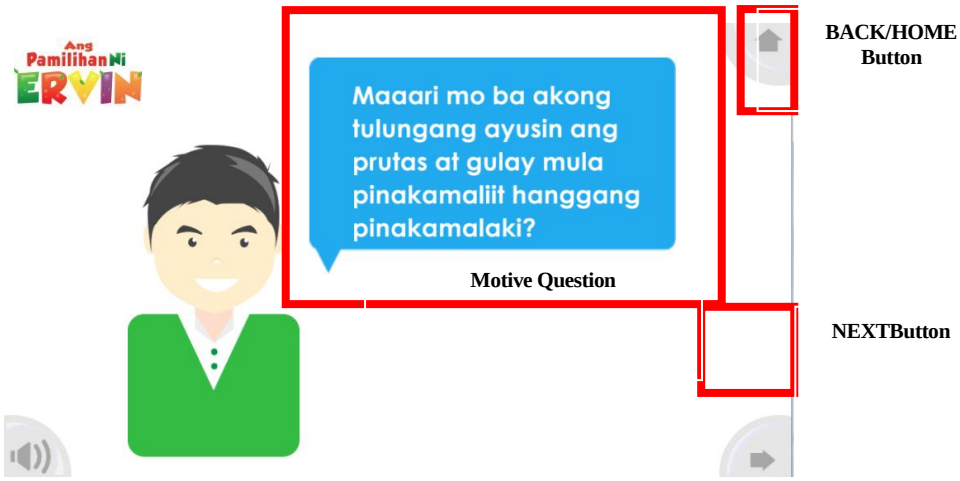
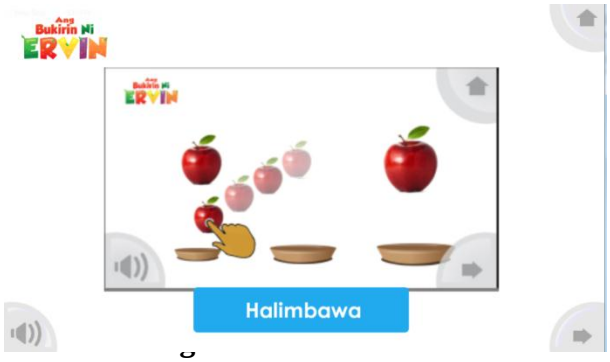


Figure 7: Mini Game Navigational Options

After the motive question, a tutorial screen appears as **Halimbawa**, shown in Figure 8 .



Sample Activity in the Mini Game : Pinakamaliit Hanggang Pinakamalaki

In this mini game, the user player should arrange the fruits and vegetable in the

order of size from smallest to largest by “drag and drop”.

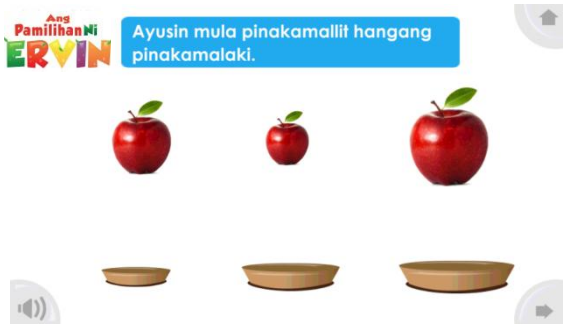


Figure 9: Sample Activity

D. HOW TO EXIT/ QUIT PLAYING

When using the PC version, the user can click /tap the exit (X) Button as shown inFigure 10.

Figure 10: Exiting on the PC version

When using Android OS Tablet or Mobile, Press the **Main Menu or Home Button** of the device as shown in Figure 11.

Figure 10: Exiting on Android OS Tablet or Mobile

Installation Guide

I. Introduction

This document serves as a quick installation or setup guide for Ang Pamilihan ni Ervin Android mobile game application and Windows desktop application. This includes step by step procedure on how to install and run the game on both Android mobile and personal computer(PC).

Before you start, you should have the installation disc with the required files. The installation disc includes the following documents and files:

Documents:

User's Manual (User's Manual.pdf)
Installation Guide (Quick Setup.pdf)

Files:

Android Package/Installer (PamilhanNiErvin.apk)
Compressed Application Folder (PamilhihaNiErvin_PC.zip)

If the following documents or files are missing on the installation disc, you may contact the Ang Pamilihanni Ervin production and development team or the Philippine Normal Universit Special Education Department for a new set of installers for this software package.

You can now start installing the application.

II. Installing the AngPamilihanni Ervin Application on your Android Mobile Device

For this procedure, you will need the file **PamilihaniErvin.ap**k. This file is the installer for Android mobile application.

1. **Choosing your mobile device.**

   In this step, make sure that you have a working Android mobile device on hand. There is no recommend mobile device for the application. Different brands of Android mobile device will work. You can use a smart phone, tablet or even hybrid phablet for the Pamilihanni Ervin app. The only thing is that your device should be running on Android(operating System) OS.

2. **Preparing your mobile device.**

   After choosing which brand and kind of Android mobile device to use, you may now prepare your device for installation.

   a. The device should be in good hardware and software condition. This will let you install or use the application properly without any interruption due to hardware malfunctions and errors.
   b. The device should be in good battery condition. This will let you install your application continuously without being interrupted by power loss.
   c. The device should not have any installation permissions set up. In this case, you are highly advised to disable restrictions on installing application from different sources.
   d. The device should be capable of file transfer (PC to Mobile, vice versa). In order to transfer file from pc to mobile and vice versa, you should now which medium you will be using. Modern Android mobile devices are now capable of transferring files wired or wireless.
      i. For wire file transfer, you are expected to use any data cable the will suite your device model USB port and the computer's USB port. Certain permission on file transferring was set depending on your device model.
      ii. For wireless file transfer, you may use your device and PC's Bluetooth technology and/or any wireless file transfer medium available.

3. **File Transfer**

   Copy the file "PamilihanNiErvin.apk" from the installation disc to any of your preferred directory on your Android mobile device. File transfer medium may vary on what is available and /or what you want.

   Note: Do not delete the original source file on the installation disc.

4. **Installing the application on your Android mobile device**

   Click/Tap the file (PamilihanNiErvin.apk) transferred to your Android mobile device. From this point, the device will now show you options on how to install the application. Options may vary on device branding or model. Don't worry, this step will be as easy as clicking "**Install**", waiting while the application is "**Installing**" and run the application if it is "**SuccessfullyInstalled**".

Enjoy playing AngPamilihanNi Ervin on your Android mobile device!

III. Installing the AngPamilihanni Ervin Application on your Desktop Computer (PC)

For this procedure, you need the file **PamilihanNiErvin_pc.zip**. This file is a compressed application folder for the Pamilihanni Ervin application.

1. **Transferring and Extracting compressed application folder.**

   Transfer the file "PamilhanNiErvin_pc.zip" from the installation disc to your preferred folder on your Desktop Computer. After transferring the file, extract the content on your preferred folder. You will notice folders and files being extracted on your folder. These files are the PamilihanNi Ervin app application.

*Do not remove or delete any of the extracted files/folders.

2. **Running the application.**

   After successfully transferring and extracting the files. The application is as good as installed on your computer. To run the application, you must look for the file "PamilihanNiErvin.exe" on the folder where you extract the files. This file is the PamilihanNi Ervin application's executable. Run this executable file. After this, the application should be running on your computer.

   Create a shortcut pointing to the "PamilihanNiErvin.exe" to avoid accessing the installation folder every time you want to play the application.

IV. End of The Installation Guide

For technical issues on installing the application on your Android mobile device or PC, you may contactthe Ang Pamilihanni Ervin production and development team or the Philippine Normal University Special Educationfor further inquiries

CURRICULUM VITAE

Name SALUPARE , ERVIN DE LUNA

Date of Birth June 18, 1988

Place of Birth Lipa City, Batangas

Educational Attainment

Graduate Studies Master of Arts in Education with specialization in Special Education
Philippine Normal University; 2016

Collegiate Bachelor of Elementary education Major in Special Education
Lipa City Public College ; 2009

Work Experiences

2014-Present Teacher I
Senator Claro M. Recto Memorial School –Lipa
SPED Center
Lipa City

2012 –Present -College professor /lecturer on Special Education
De La Salle Lipa

2009- Present -Home - Based Instruction Program facilitator for Children with Autism Spectrum Disorders, Global Developmental Delay, Seizure Disorder and Communication Disorders

2012- 2013 - Provincial School Board Teacher
PaaralangSentralngMataasnakahoy
Matasnakahoy ,Batangas

2009-2011- Early Intervention Program Teacher forChildren with Autism and Global Developmental Delay and a Developmental Interest Relationship -based (DIR) /Floortime therapist at Children Developmental Intervention Center of Lipa

Socio Civic Exposure

Resource Speaker for Local Seminars on

- Special Education
- Common Pediatric Disabilities

Affiliations

- Philippine Mental Health Association Lipa Chapter