EduCaNet: A LEARNING MANAGEMENT SYSTEM (LMS) FOR SPED TEACHERS HANDLING CHILDREN WITH SPECIAL NEEDS

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Abstract

Special education refers to teaching students with unique differences, disabilities, and special needs who require extra attention toward their educational needs. It uses personalized teaching methods and customized equipment to create accessible learning environments. The Department of Education (DepEd) of the Philippines has issued an order to support inclusive learning to educate every student, irrespective of their learning styles, backgrounds, or aptitudes. It describes integrating students with disabilities into regular education classes while offering them the assistance and accommodations required to succeed in that environment. On the other hand, educators voiced concerns about inclusive education, citing issues, including workload, suitability, and resource availability. As a result, the EduCaNet desktop application was designed for educational institutions to facilitate easy access to informative resources, monitor student progress, and enhance the learning experience. In order to acquire data, the researchers used quantitative and qualitative methodologies. The application was developed simultaneously using an iterative design method that entails repeated planning cycles, requirements gathering, analysis, design, development, testing, evaluation, and deployment. Respondents who tested and evaluated the application's usability participated in an assessment that used the Unified Theory of Acceptance and Use of Technology (UTAUT2) to get significant and helpful user input. The evaluation results indicate positive responses from parents/guardians and teachers regarding the system's usability and effectiveness, leading to recommendations for further system enhancement and improvement.

Keywords: learning management system, LMS, learning materials, special education, SPED, teacher, SPED teacher, children with special needs, desktop application

1 Introduction

Separate schools, classes, or teaching created especially for children with special needs who require extra attention towards their educational needs are referred to as special education (SPED) or special needs education [60]. These types of teaching are made for students who have special needs, may it be their cognitive, behavioral, intellectual, or social aspects, in meeting the learning objectives set by their chosen learning program. Is there a need for adaptive, specialized learning? Why not let the child go and try to follow as best as they can? The answer to that is in the declaration of the Rights of the Child proclaimed in 1959 during the United Nations General Assembly, which states, "The child who is physically, mentally or visually handicapped shall be given the special treatment, education that is required of his particular condition." If it is attainable, quality education should be given to children as it hones their cognition, which serves as the foundation for their social and emotional skills and plays a crucial role in their overall development, enabling them to attain the essential knowledge and skills required for achieving success in various endeavors [3]. Proper education further nurtures moral values and allows children to develop life skills to make good decisions and attain their best versions [64].

Special Education (SPED) programs utilize individual approaches, including Individualized Education Program (IEP) and different sets of instructions to accommodate each student's learning needs [62]. SPED teachers use specialized techniques, including behavior strategies and multi-sensory methods to support students with special needs in their learning journey [8]. Additionally, SPED classes are usually smaller than regular classes to provide more personalized guidance to students with special needs [66].Several components plays a crucial role in determining the quality of learning received by students, binding them closer to their development. These components include educational content, learning environment, school management, pupil preconditions, school funding, school resources, and finally, the

professionalism of the school's educators [35]. The responsibility of a teacher is to raise, guide, and educate children so they can contribute to society since they are responsible for making a massive impact on the student's education [2]. Challenges and setbacks frequently arise in the teaching and learning process, posing difficulties for dedicated educators who strive to engage students while being concerned with their growth [59].

In 2009, the Department of Education (DepEd) in the Philippines issued Department Order No. 72, which sought to facilitate inclusive education to enhance the participation rates of children [1]. However, notable concerns were expressed by teachers regarding inclusive education [31]. These concerns encompassed the availability of assets, tasks, and challenges of inclusive education. Thus, teachers face various challenges when dealing with learners with special educational needs (LSEN). These challenges include addressing behavioral problems, communication difficulties, insufficient parental involvement, lack of materials, and chronic absenteeism [45]. One of these challenges can be the difference in how every student absorbs the class material, which is heavily influenced by the teacher's teaching style [13]. Teaching styles are referred to as the personal characteristics that determine a teacher's teaching strategies and behavior [42]. The significance of teaching becomes apparent as academic achievements improve when instructional approaches are aligned with the student's learning preferences, resulting in a focus on meeting their needs and enhancing the learning progress [67]. Teachers need to use different teaching styles to be effective because it significantly impacts how much knowledge students gain from the materials presented in class [4]. In order to achieve fairness, it is often expected that teachers treat all students equally and start from a common baseline. However, this can become challenging when students have varying interpretations of the educational content, as it raises concerns about the teacher's effectiveness in delivering instruction [4]. In order to achieve fairness, it is often expected that teachers treat all students equally and start from a common baseline. However, this can become challenging when students have varying interpretations of the educational content, as it raises concerns about the teacher's effectiveness in delivering instruction [21].

There are 13 recognized distinct categories of disabilities which include, autism, dual sensory loss, hearing impairment, emotional impairment, intellectual impairment, multiple impairment, specific health impairments, specific learning disability, language learning disability, blindness or visual impairment, and traumatic brain injury [30]. The Individuals with Disabilities Education Act recognizes these 13 categories and sets the guidelines for how both public and state agencies offer special education for early intervention and other assistance to younger children, adolescents, and youth with disabilities who are eligible for assistance [38]. However, teaching problems in special education have been identified in the study of Allam and Martin in the year 2021, which include limited approaches, difficulties in identifying individual needs, inadequate numbers of Special Education (SPED) teachers, and the need for more budget [5]. They further discussed that in some institutions, it turned out that special education teachers needed specialized training and had limited strategies for coping with students with special needs. Additionally, the disclosed number of institutions specializing in special needs education for teachers is limited compared to the number of institutions offering regular education. Hence, the need for current curriculum guides, teacher guides, and professional development seminars among the teaching workforce. This shows that there are challenges regarding the pursuit of inclusivity in schools as well as why it is difficult to provide a more accommodating and nurturing environment to those with special needs. Moreover, due to poverty and lack of parental understanding of the educational services offered to children with disabilities, there are fewer kids with disabilities in the school system [65]. In the Philippines statistics say only 93,895 students with special needs were enrolled in a school, a 74 percent decrease from the 360,879 kids enrolled during the pre-pandemic period. This notable withdrawal of enrolling their special needs children in school will provide a detrimental upturn in their kids' development if it continues by a long shot [63].

In 2022, there are 1.6 Filipino children with disabilities, a number that is on the rise [27]. Among these, 65 percent of the disabled learners community in the Philippines were not enrolled in any Department of Education (DepEd) schools, with some receiving home-schooling by parents who were not fully equipped with the proper styles of teaching children with special needs [14]. The increasing rate of overlooked students led to the establishment of the Republic Act 11650, or Inclusive Education Act of 2022, to ensure students with disabilities have access to quality education and health services, basically providing learning support to students with disabilities. However, it was estimated that it would take at least five years for the Inclusive Learning Resource Center (ILRC), public and private, to fully comply with the law for students with special needs [14]. In a study by Dr. Carington, a multitude of challenges in transitioning to inclusive education were identified. These include a lack of resources and infrastructure, unavailability of services, special education teachers, and classrooms, the lack of comprehensive and up-to-date statistics on children with special needs, as well as the preparedness of teachers and school officials inadequacy of services, shortage of specialized teachers and classrooms, absence of comprehensive and current data on children with special needs, and the unpreparedness of educators and school administrators are all indicators of the issue at hand [25]. The great delay in the passage of inclusive quality education will clearly distort the child's development

as the benefits of quality education are far beyond what is learned at home [37].

Educational objectives can be categorized into cognitive, affective, psychomotor, and intuitive skills. When an individual learns, they also acquire associated psychomotor, affective, and intuitive behaviors, which fall under four different domains of learning [55]. Children with special needs (SN children) do not perform well academically as regular students because their emotional or behavioral issues prevent them from using their cognitive skills to their full potential [51] [20] [58]. Regardless of the amount spent on services specifically in school health services, counseling, occupational therapy, physical therapy, and "other support" services, total students enrolled, and the academic achievements of students with disabilities (SWDs) remains quite low[50] . When it comes to grasping lessons, children with special needs face a range of challenges which include learning problems related to motivation, interest, and attention span issues [6]. One could categorize attention and memory as components of overall cognitive processes, either as part of executive function, or associated with abilities related to learning [44]. For example, individuals with a learning disability exhibit a heightened susceptibility to experiencing a lack of motivation. Therefore, a combination of motivational issues and attention problems will likely impede the learning efforts of students with learning disabilities [46]. Additionally, similar challenges are observed in individuals with autism in their academic performance, such as processing information, managing their time effectively, collaborating in a group setting, delivering presentations, and maintaining study motivation [28].

Aside from the challenges in teaching children with special needs, there are also challenges when it comes to the workforce. As of the latest statistical data from DepEd, there are a total of 876,842 teachers from basic education and 4,882 are SPED teachers nationwide [19]. n addition, the suggested student-to-teacher ratio for Special Education (SPED) was 15:1. However, statistics presented that there are presently a total of 126,598 students who have disabilities, leading to a student-to-teacher ratio of 31:1. It is plain to see that there is a distinct requirement to assist learners with disabilities. It is essential to note that among the 13,408 educational institutions in the Philippines that provide Special Education (SPED) programs, only 648 establishments operate as exclusive SPED centers. Out of the total, there are 471 centers in elementary schools, whereas in high schools, there are 177 centers [24]. In the Davao region, there are a total of 27 schools offering special education (SPED) programs, including 8 public elementary schools, 11 public high schools, and 8 private schools [40]. In summary, the statistics mentioned above emphasizes the need for support systems to address the shortage of educational institutions and special education teachers.

Due to lack of training and fear that they won't be able to offer enough assistance, regular schools continue to reject children with special needs. Public schools, in contrast, often welcome these children. However, inclusion or special education programs need more resources or trained teachers to provide proper support and individualized education programs for these children [14]. When a child with special needs enrolls at a non-SPED school, the institution seeks to establish an inclusive environment alongside their peers who do not have special needs [28]. As a result, the general education instructor is obliged to create the necessary curriculum modifications for children with special needs in their classroom in order for them to attain academic requirements, allowing these students to succeed alongside their peers [36]. The National Centre for Accessible Educational Materials states that it is a requirement for educators to develop accessible resources and make modifications for students with impairments. This approach can take time because it entails developing new materials or altering existing ones, offering assistive technology, and creating other necessary accommodations. The ultimate objective is to guarantee that all children have access to the same resources and curriculum [24].

In a global setting, one in five households has a child with special needs [12]. In a survey about the effects of the implementation of inclusive education in centers in the country of Kenya was conducted among teachers and parents. As for the results, 78 percent of the participants of the respondents agreed that they needed more resources due to their lack of educational-related materials and technologies, which would help them assist learners and ultimately affect the quality of education for children with disability [39]. The inclusive education Act is a law that would aid the schooling of each individual with special needs. However, the Department of Education (DepEd) claimed the 532 million pesos proposed budget was not considered by the National Expenditure Program (NEP) and therefore, it bears nothing but false hope to the special needs community [18]. There are teachers who are eager to teach but are physically unable to due to the ratio of their active student population, which is 15:1 [**?**]. This unexpected outcome has left the parents of these children searching for tutors who are committed to the continuation of education for their children with special needs [14].

Educational institutions and programs should receive sufficient and equitable funding, along with non-discriminatory, learner-friendly, and cost-effective technologies. Examples of these are books, learning materials, and open educational resources. These resources should be tailored to the learners' context and made accessible to individuals of all ages, including children, youth, and adults [61]. There is a growing number of technologies available that can aid educators, parents, and children with special needs in enhancing communication and exchanging information to improve their academic achievements [53]. As educational technologies,

these are defined as an integrated tool, resource, or practice that assists learning or enhances learning outcomes [41]. Educational technologies encompass tools, resources, and practices intended to bolster learning and improve results, with a particular emphasis on their integration into special education courses to support both learning and teaching that includes diverse array of items such as students' utilization of computers or tablets, teachers' utilization of whiteboards and presentation tools, and learning management systems (LMS) [54].

With the emergence of computers, the use of technology in education has changed significantly, and a range of options to help learning and teaching processes have developed [11]. Significantly, technologies have demonstrated their effectiveness in granting students with disabilities access to essential information, consequently contributing to their academic achievements [26]. Digital technologies serve as a means to support students with disabilities in their learning journey [49], achieving this by implementing learner-centered approaches tailored to their specific needs (e.g., through differentiated instruction, addressing visual/audio preferences) [34] [52]. Furthermore, reports indicate that teachers have increasingly adopted technology to monitor student progress, extend emotional support, collaborate with parents on instructional tasks, and provide aid through tools such as graphic organizers and teacher-generated presentation slides [47].

An increasing number of parents who have children with special needs are also turning to the internet to find information, resources, and social support [64]. Parents depend on their existing support networks, like family or friends, who have always been their primary source of various kinds of support [17]. Finding relevant information and connecting with others finds it difficult for the parent of a child with a disability [10]. Although the internet provides vast information, it may not always be helpful or accessible especially when it comes to families with children with disabilities since their needs are unique, and the information available online may not always cater to their specific requirements [7]. In summary, the information suggests that parents of children with special needs may encounter difficulties in locating online resources that are relevant and beneficial. Therefore, to address this issue, it is essential to create accessible websites, documents, and digital content for individuals with disabilities. More importantly, it is essential to ensure that the information provided online to parents of children with special needs is reliable, relevant, and easily accessible.

Recent technological advancements have demonstrated a great potential for enhancing the teaching and learning experience, particularly in special education. These advancements include alternative computer interaction methods, advanced processors, high-definition graphics, and enhanced online communication and collaboration tools over the Internet, facilitating learning environments for students, teachers, and parents that can lead to improved outcomes [48]. There are available online platforms for special education that assist the teacher and offer resources. Examples of these platforms that are accessible online are Amplio, PowerSchool, embraceIEP, TeachTown, and many others.

General services

Platforms such as Amplio and PowerSchool Unified Classroom provide excellent opportunities to assist school administration and special education teachers or educators. Amplio integrates functionalities from conventional LMS platforms with tools that are tailor-made for special education [9]. The primary benefits of the system are its flexibility and customization. It allows for the development of personalized curricula and tracks the progress and growth of each individual student. Amplio's reporting capabilities enable effortless recognition of areas where students are facing difficulties and finding potential remedies. The key features include AI-based, organized learning approach, automation, and adaptability. In addition, the programs are created to provide students with comprehensive and challenging education that equips them for achievements, both in their academic pursuits and their daily lives [15].

On the other hand, PowerSchool is a unified system that connects students, teachers, admins, and parents with the shared goal of improving student results [16]. The system efficiently managing special education, finance, human resources, talent, registration, attendance, funding, learning, instruction, grading, assessments, and analytics efficiently from the office to the classroom to the home. Meanwhile, the key features of the software include special education case management, a student information system, learning management system, an online portal, response to intervention, modules for gifted and talented students, and English language learners [9].

Resource services

EmbraceIEP and TeachTown are platforms that offer tools and resources catered for special needs. The embraceIEP is a software that assists in the development and execution of Individualized Education Plans (IEPs). This software is intended for use by teachers, school administrators, and parents. The software offers various functions that simplify the development and monitoring of IEPs, such as goal tracking, progress reports, and resource accessibility. It comprises various key features including a customizable system, monitoring, real-time translations, integration, and other features which are easy student transfers and exceptional support from embraceIEP team [9].

Alternatively, TeachTown serves as a web-based hub designed to empower teachers by providing them with materials and utilities to support students who face moderate to severe learning challenges. The system includes engaging

interactive exercises, tasks, and study sheets, all geared towards facilitating the development of crucial academic and interpersonal proficiencies in students. Additionally, the platform delivers tools for educators to monitor and analyze student progress effectively. TeachTown's key features include assessment, lesson planning, progress tracking, and parent communication tools. These tools help educators determine a child's level of functionality and needs, create effective lessons, monitor progress, identify areas for improvement, and keep families informed about their child's progress [9].

Among the technological solutions presented, one of the notable shortcomings is the absence of learning management systems focused on children with special needs available in the Philippines. More importantly, up in the market or existing learning management system specialized for SPED is not accessible due to country district codes like in the United States. In addition, these applications are paid and subscription-based and offer pre-built content. However, the origin or basis of the content provided by these applications, whether it follows a specific curriculum or pertains to a particular country, remains ambiguous. Despite this, the content can be customized to suit the needs of certain students and can be employed in the Philippines. On top of that, problems in user experience exist, such as navigation for new or old users, confirmation prompts, glitches, and the inability to see scholar growth progress as admin. It is imperative to incorporate and address all the mentioned problematic features and functionalities, emphasizing an easy, friendly, helpful, and accessible platform catering to an online learning management system for children with special needs, assisting the teachers, parents, and administrators

address further the difficulties experienced by teachers and accommodate accessibility to educational resources, the researchers propose EduCaNet, a Learning Management System (LMS) specifically for Special Education (SPED) schools. A Learning Management System (LMS) is used to manage, oversee, record, and deliver training courses and programs [32]. It serves as a platform through which organizations can generate, manage, present, and monitor online learning content. EduCaNet aims to enable teachers to set up virtual classrooms tailored to the individual needs of SPED students and would allow teachers to track each student's progress efficiently. EduCanet is a desktop application suitable for teachers, students with special needs, and parents of the children themselves. EduCaNet enables the users to access educational resources like videos, worksheets, lessons, and monitor the child's educational progress. EduCaNet aims to strengthen the learning of the Special Education (SPED) community with these integrated functions.

1.1 Objectives of the Study

1.2 General Objective

A Learning Management System for Special Education schools is the primary objective of this project which enables them to monitor the progress of the child and access educational materials.

1.3 Specific Objectives

The researchers aim to achieve the following goals:

a) Develop a Learning Management System that will:
b) Enable teachers to create numerous virtual classrooms.
c) Enable teachers to add progress to Special Education students and assign materials based on their needs individually.
d) Incorporate evaluation tools for students through adding personalized notes and evaluated assessment questionnaires.
e) Enable parents and students to view educational materials assigned by their subject teachers.
f) Enable parents to monitor their child's progress
g) Use the Unified Theory of Acceptance and Use of Technology to evaluate the application's usability.

2 METHODS AND MATERIALS

2.1 Research Method

The researchers used mixed methods combining quantitative and qualitative research approaches to address and answer questions or problems. For the qualitative method, the researchers conducted data collection activities, which involved executing interviews, analyzing related articles, journals, and studies. By utilizing this approach, the researchers acquired valuable knowledge and insights regarding the selected topic. The researchers defined the study's goal to develop EduCaNet, a desktop application designed for teachers, parents of children with special needs, and the children themselves. For quantitative methods, users assessed the application usability using the Unified Theory of Acceptance and Use of Technology (UTAUT2) survey questionnaire as their assessment tool.

Throughout the whole research period, the researchers selected participants to interview who met specific criteria, including teachers teaching children with special needs and parents of children with special needs. The data originated from six educational institutes that provide education for children with special needs, which are Wireless Elementary School, Buhangin Central Elementary School, Rizal Special Education Learning Center, Inc. RICAFI, The Lamb of God Sped Academy (LGSA), Independent Living Learning Centre (ILLC) and Tiny House. The participants collaborated willingly with the researchers, actively contributing their viewpoints and suggestions to facilitate the further advancement of EduCaNet

2.2 Conceptual Framework

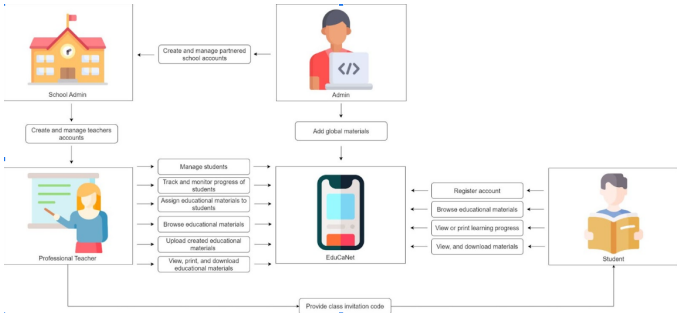


Figure 1. EduCaNet Learning Management System

EduCaNet is a desktop application for a Learning Management System (LMS) designed to support teachers teaching students with special needs in educational institutions. EduCaNet simplifies finding educational materials, managing students, and keeping track of the student's daily progress. In the context of its business model, EduCaNet will implement a business-to-business strategy. Educational institutions will be required to subscribe to the platform and make monthly payments in order to gain access to the application.

The admin of the application is the one who will make an account for the school admins and is responsible for uploading globally made or contributed educational materials for students with special needs. Teachers can skip registering because the school admin will provide their accounts. Once they have their accounts, teachers can give a class code to let the parent of the child enter the online classroom. Once entered, the teacher will be the one managing the students by tracking and monitoring their educational progress uploading and assigning educational materials.

For student registration, either the parents or guardians of the learners with special needs are responsible and in charge of the student's account, accommodating them to enter the appropriate online classroom. This access not only allows them to enter the classroom but also gives them access to the exclusive educational resources provided by their assigned teacher, browse academic materials suited for their child, and keep track of their child's educational journey. More importantly, parents or guardians are required to assist the child not only in accessing their account but also in effectively utilizing the Learning Management System (LMS). Materials can be downloaded for offline use, ensuring accessibility even in areas with limited internet connectivity.

2.3 Design Procedure (SDLC)

The researchers chose the iterative design process to ensure the delivery of an application that meets the approval of our clients. Iterative from the name itself has repetitive cycles, encompassing initial planning, planning, requirements gathering, analysis and design, development, testing, evaluation,

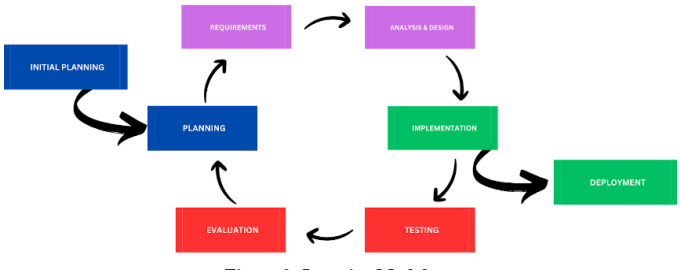


Figure 2. Iterative Model

and deployment [32]. This iterative process will allow us to take in client feedback and make necessary adjustments to ensure the delivery of an application that meets all requirements.

2.3.1 Initial planning: The researchers and their adviser conducted a group discussion to tackle the difficulties encountered by teachers handling children with special needs, parents of children with special needs, and the children themselves.

2.4 First Iteration

2.4.1 Planning: On the initial day of the planning phase, the researchers strategically assigned roles among the team members tailored to their respective areas of expertise. The roles such as Document Expert, Project Manager, and Developer were distributed to optimize the workflow and enhance project efficiency.

The researchers began to read related literature to validate the information gathered from the interviewees, consisting of qualified teachers and school directors. From the problems discovered, the researchers cultivated a solution: a Learning Management System that enables a teacher to create a virtual classroom, manage students, track their progress, and browse educational materials for both teacher and parents. This desktop application aims to enhance the collaboration and personalize learning within the SPED community.

The researchers picked 5 participants that met specific criteria: 3 parents of children with special needs and 2 employed teachers with experience handling children with special needs aligned with the research objectives. The data collected came from Wireless Elementary School and Buhangin Elementary School, and Tiny House Therapy and Learning Center, a therapy learning center. The teachers interviewed came from educational institutions, whereas the parents are associated with the therapy center.

Based on the interview conducted with the teachers, children who are not diagnosed but show manifestations based on their observations are being so-called "tagged" to inform the other teachers that this child may have possible special needs. Low attention span leading to being disruptive, especially when uninterested, is the usual problem parents

and teachers share. Children with special needs, specifically children with intellectual disability (ID) and attention deficit hyperactivity disorder (ADHD), find it difficult to process information. If they skip even for a day what they learned from school, they tend to forget it. Teaching these children requires patience since their pacing differs from those without learning problems. Children with special needs require different approaches when answering tasks or materials in a general class. Most of their tasks are designed by their teachers to be understood easily, and sometimes teachers will find more inventive ways for these children to understand the lessons.

As the researchers introduced the theorized solution, the teacher agreed with their proposition. The same educators also shared that many parents asked them for tutoring services for their children.

The researchers also interviewed parents that have children with special needs. According to them, despite their willingness to teach, parents of these children have spoken about concerns such as their capacity to teach their child, the limited time they have to provide for the family during the day, and their inability to be fair towards their child as they seem to be withdrawn from the topic proper which makes them feel utmost pity. As a result, they want to hire a tutor for their children to help them with their academic needs

2.4.2 Requirements Gathering. Primary data collection was performed through structured interviews with parents and teachers. The parents' interviews were focused on understanding the challenges and requirements of tutoring for special education students from a household perspective. This interview was conducted at the therapeutic center based in Davao 'TINY HOUSE 3'.

Conversely, the teachers' interviews from Wireless Elementary School and Buhangin Central Elementary School in Davao City aimed to capture the educators' viewpoint. It centered on understanding the difficulties they face while tutoring and their insights on what could enhance the learning experience for the students.

Lastly, the researchers have identified several features that will be integrated in the application which includes, direct payment, search feature for a suitable tutor for their child based on their needs, to view teacher profiles, and buying or selling of educational materials for monetization.

2.4.3 Analysis and Design. The researchers created a wireframe of the application that represents the application's user interface. This will help the programmer visualize the layout and functionality of the application. Lastly, the researchers created a landing page of the application to allow them to have a guide for the structure of the website.

Functionalities and features are listed below:

The researchers will utilize several powerful tools offering distinct advantages in implementing the project. Visual Studio Code, the chosen code editor, provides a lightweight and customizable environment with extensive language support and debugging capabilities [33]. Its versatility and numerous extensions make it an ideal choice for efficient development. Flutter, an open-source toolkit from Google, has been selected for user interface development [23]. Using Flutter, the researchers can build natively compiled applications for various platforms, including mobile, web, and desktop, all from a single codebase. To handle the backend infrastructure, PocketBase emerges as a valuable solution as an end-to-end backend server. PocketBase provides sets of secured api, offers built-in user authentication, database management, and cloud storage [43]. PocketHost as a hosting service for PocketBase as this enables seamless integration of backend functionalities [29]. Finally, the researchers will utilize Figma, a cloud-based design tool. Figma enables collaboration and real-time editing among multiple users, streamlining the interface design and prototyping process [22]. With these tools, the researchers can achieve a streamlined and efficient implementation process, delivering a robust and user-friendly solution.

Table 1. Technology tools Implementation of the application

Tools	Description
Visual Studio Code	Lightweight programming IDE developed by Microsoft, this allows supporting multiple programming languages and offers code completion and customization
Flutter	Developed by Google, this allows developers to build and compile web, desktop, and mobile applications using a single codebase.
PocketBase	PocketBase is a public domain backend that includes an integrated database with live subscriptions, in-built authentication management, user-friendly dashboard interface, and uncomplicated REST-like API.
PocketHost	A cloud hosting platform for PocketBase.
Figma	A cloud-based design tool used for user interface prototyping and designing. Multiple users can work simultaneously on projects in real-time.

2.4.4 Testing: In this phase, the researchers presented the wireframe and prototype to educational institutions where the researchers can find potential users of the application, which are teachers and parents of children with special needs.

2.4.5 Evaluation: The researchers presented their proposed capstone project to the panelists. During the defense, the panelists advised the researchers to shift their focus from booking to a learning management system. The target audience for the researchers remains the same, which is special education.

2.5 Second iteration:

Following the first iteration, the researchers move into the second iteration of the stages, incorporating updates and adjustments based on the learnings from the previous cycle. There are features from the initial proposed solution that have been retained, there are also features that have been removed and changed. Still, the main focus of the researchers are in the field of special education.

2.5.1 Planning: Together with the researchers' adviser, they have planned their next steps after the redirection suggested by the panelists. They identified what functions need to be removed and retained. The researchers gathered information from the interviewees, consisting of qualified teachers and school directors. They presented the idea of a desktop application for a Learning Management System that enables a teacher to create a virtual classroom, manage students, track their progress, and browse educational materials for both teacher and parents.

The researchers picked 4 participants who met specific criteria: 2 school directors and 2 employed teachers with experience handling children with special needs aligned with the research objectives. The data collected came from 3 institutes, Independent Living Learning Centre, Rainbow Intervention Center For Autism Foundation, Inc. (RICAFI), and Rizal Special Education Learning Center.

A teacher from Rizal Special Education Learning Center added there are lots of educational materials on the internet. However, it takes time for them to find effective and proper educational materials that will be used during their class. Everything was done by using different software, from finding and making educational materials for different needs of the children, creating progress reports of a child with special needs, and sharing the progress of the child with their parents or guardians.

The researchers didn't get any problems from ILLC Davao since their main focus is how children with special needs will live independently in the real world. In addition, The program director of ILLC volunteered their institution to be one of the application testers once EduCaNet is developed since the Independent Living Learning Centre (ILLC) focuses mainly on therapy and special education programs for youth with autism, down syndrome, slow learners, and other special needs.

2.5.2 Requirements Gathering: The researchers conducted structured interviews with professional teachers and school directors to gather primary data. The discussions centered around exploring the difficulties they face when working with children with special needs, particularly in finding and creating educational materials that are most effective for individual students. This process often involves trial and error to determine which materials will help these students learn and maintain their interest.

Moreover, the researchers identified several key features to incorporate into the Learning Management System (LMS). These include the making of a virtual classroom where the teacher will give a unique code to a student for them to join, assign educational materials to a student, add notes to track the student's daily progress, and allow the parents to read the progress of their child virtually, teachers evaluation of each student, and for teachers and parents to easily find educational materials.

2.5.3 Analysis and Design: The whole user interface was redesigned by the UI designer of the team since the presented idea during the first defense was redirected from booking to LMS. Making the prototype of the application is instrumental in helping the researchers visualize and comprehend the app's interface, structure, and functionalities. This enabled them to gain a comprehensive understanding of how the desktop application should be developed. With the gathered information from the target users, certain functionalities were removed and retained. The following are the modules and how these modules benefit the users:

Table 2. Modules and Functionalities on Admin side

Tools	Description
Manage Account	This feature will allow the admin to create and delete school admin accounts.
Manage global materials	This feature will allow the admin to add global materials for the teachers and parents/students to use.

Table 3. Modules and Functionalities on Admin side

Tools	Description
Manage Account	This feature will allow the school admin to create and delete teacher accounts.

Table 4. Modules and Functionalities on teacher side

Tools	Description
Manage virtual classroom	This feature will allow teachers to establish multiple virtual classrooms. Each classroom generates its own unique code for children/parents to join.
Manage students	This feature will allow teachers to add owned educational materials, assign materials, track progress of the child, and evaluate them.
Browse Digital Materials	This feature will allow teachers to browse materials uploaded by the admin from different authors.
File manager	This feature will allow teachers to upload their own materials and assign materials to students.

Table 5. Modules and Functionalities on student/parent side.

Tools	Description
Classroom access	This feature will allow children / parents to enter the classroom using the class code provided by the teacher.
Student profile	This feature will allow the children/parent view the materials assigned, progress report, and evaluation of the teacher.
Browse Digital Materials	This feature will allow parents/students to browse digital materials and can download it for them to access it for offline use.
File manager	This feature will allow teachers to upload their own materials and assign materials to students.

2.5.4 Implementation: The programmer from the researchers started the coding and development process of the application. This stage aims to transform theoretical planning into a practical and functional application. The tools used for implementing the desktop application remain unchanged.

2.5.5 Testing: During the testing phase of the user interface, the researchers presented the prototype, explained the flow of the application, and gathered feedback from three special education teachers. Two from Wireless Elementary School and one from the Lamb of God Sped Academy.

2.5.6 Evaluation: The participants were satisfied with the presented prototype, especially the user interface, as it is user-friendly and easy to navigate. With the help of the participant's insights, it was then concluded that the design of the application and the functionalities were final. Additionally, the principal of Wireless Elementary School agreed that their special education teachers would be one of the testers of the application once it is done and help evaluate the educational materials made by the non-programmers of the group as it will be integrated into the application. Additionally, the SPED teacher from The Lamb of God Sped Academy also agreed to be the application testers.

2.6 Third Iteration:

As the project advances into its third and final iteration, each phase is geared towards refining the desktop application to its best version.

2.7 Planning:

In this phase, the researchers sent letters to educational institutions that have SPED teachers with knowledge of educational materials for children with special needs and experience in evaluating SPED students. These institutions include Rizal Special Education Learning Center, Inc., The Lamb of God Sped Academy, Wireless Elementary School, and the Independent Living Learning Centre (ILLC) Davao.

Only two out of the four institutions agreed to participate in interviews with their SPED teachers. These interviews included two teachers from Wireless Elementary School and a SPED teacher from The Lamb of God Sped Academy. During the interviews, it was concluded that educational materials should be simple and concise, as these children have a limited attention span. The institutions also mentioned that they evaluate the student's academic performance periodically. In addition, the researchers sent letters to the four institutions to be part of the testing phase of the application after its development.

2.7.1 Requirements Gathering: In this phase, the researchers made their student evaluations for students with special needs with the assistance of the guide given by the SPED teacher from Wireless Elementary School. After completing the evaluation, they had it validated before integrating it into the application, and the SPED teacher from Wireless Elementary School approved it. Additionally, SPED teachers from The Lamb of God SPED Academy contributed lessons and worksheets that will be integrated into the application and as an exchange, EduCaNet will put the names

of the teachers as contributors for every worksheets and lessons they provide.

2.7.2 Analysis and Design: From the user's perspective from the second iteration, which was the presentation of the user interface and functionalities of the application, it was said that the user interface was simple, easy to navigate, and user-friendly, and there were no added functionalities.

2.7.3 Implementation: The programmer utilized the following technology stack to complete the desktop application: Flutter was used for designing the user interface of the application using the Dart language. PocketBase was exclusively used for the desktop application's database as it facilitates the interaction between the application and the database. Visual Studio Code was employed in creating the desktop application.

2.7.4 Testing: To ensure all the functionalities are working, the researchers run functionality tests to find any issues or bugs in the application. During this phase, the functionality of the application was tested by non-programmers of the research group and one external person to avoid bias on the application's functionality testing.

2.7.5 Evaluation: In this phase, the system is now ready to be tested by the target users since all of the functionalities are working and has been triple checked by the two non-programmers of the group and an external person who also worked in the IT industry. Using the Unified Theory of Acceptance and Use of Technology (UTAUT2) survey was applied to look into the effects of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Hedonic motivation (HM), Price Value (PV), Habit, and Behavioral Intention (BI).

2.7.6 Deployment: In this phase, the EduCaNet Learning Management System was deployed on the web. Users can download the desktop application by clicking on the intended download button for school admin, teachers, and parents.

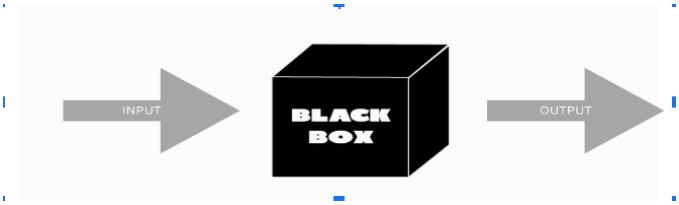


Figure 3. Black Box Model

2.7.7 Testing Procedure: The application testing procedure will primarily rely on black-box testing, where the researchers will examine the functionality of the desktop application without needing to understand its internal structure, and application usability will be evaluated using the UTAUT2 model. This method is similar to a real-world user scenario, involving the input of data and examination of the ensuing output, irrespective of the underlying processing pathways [37]. It enables testers to affirm the software's conformity to predefined requirements and identify potential discrepancies. The black box testing will provide a significant level of assurance in our desktop application's functionality and usability, promoting a user-friendly, high-quality product.

During the first testing of the application the non-programmers in the group tested the application's functions and discovered bugs that needed fixing. The issues were promptly reported to the group's developer as they needed to be fixed immediately. After the bugs were fixed, the non-programmers tested the application again to make sure that everything was working properly. Lastly, the researchers did external functionality testing to ensure that there was no bias in checking the application's functionality before letting the application be tested on the target users, who are SPED teachers and parents/guardians of children with special needs.

The users who tested the application for beta testing had a total of 21 participants. The selection criteria for testers included teachers who handled children with special needs and parents/guardians of these children.The testing took place in educational institutions . The following are schools where the application was tested and evaluated: The Lamb of God SPED Academy, Wireless Elementary School, RICAFI, and independent living learning center.

During this phase the participants engaged in a black box testing where the researchers let the users use the application, and after testing the application, the participants evaluated the application using the UTAUT2 survey questionnaire. The following test cases will be used as a guide in the black box testing:

Table 6. Admin side test case for Black Box testing

Tools	Test Case	Expected
User Access	Enter username and password	The admin will be able to input username and password then login into the application
Manage account	Create account for school admin and Delete school admin	The admin will be able to create and delete account for school admin.
Manage account	Create account for school admin and Delete school admin	The admin will be able to create and delete account for school admin.

Table 7. School admin side test case for Black Box testing

Tools	Test Case	Expected
Manage account	School admin will fill-up the registration form to create an account for the teacher.	Creates an account for teachers.
Manage account	School admin can delete the account of the teacher when delete icon is pressed	Teacher account deleted.

Table 8. Teachers side test case for Black Box testing

Tools	Test Case	Expected
User Access	Enter username and password created by the school admin.	The user will be able to input username and password then login into the application.
Manage Classroom	Click the button for adding of classroom, Click the delete button to delete classroom, Students enter the unique class code to join	The user will be able to create classroom, The user will be able to delete the classroom, Students can be seen in the classroom when entering the unique class code.
Generate Code	Generate class code to students via email for them to join the classroom.	The user will be able to receive a unique class code for students/parents to enter the classroom
Add progress to student profile	Click the add progress button to add daily progress of the child.	Allows teacher to add daily progress of the child via notes integrated in the application.

Table 9. Teachers side test case for Black Box testing

Browse educational materials	Click the material icon button for the user can see list of educational materials available and can assign to students.	Allows teachers to browse educational materials and assign to student base on the student's needs.
Manage own Educational Materials	Click add button to add a material in your own file manager, Click the assign button to assign the material to a particular student	Allows teachers to add materials in their file manager, Allows teachers to assign learning materials based on the individual needs and progress of children with special needs.

2.8 Ethical Considerations

Ethical considerations are essential principles that researchers must adhere to when conducting any form of research as these principles ensure the research is conducted with respect, dignity, protecting participants from harm, and ensuring their participation is voluntary and with informed consent [62]. In the development and implementation of EduCaNet, ethical considerations were taken into account and ensured that the well-being and privacy of all users involved.

2.9 Social Value

The development of EduCaNet as a learning management system specifically designed for SPED teachers handling children with special needs holds significant social value. It addresses the need for individualization of the learning process for students with special needs, by providing a platform where teachers can create virtual classrooms, browse learning materials to each student's specific needs, and track the progress of the students. EduCaNet has the potential to greatly improve the educational experience and outcomes for SPED students.

2.10 Informed Consent

The researchers ensured all the participants understood and received all the information on the subject matter. The letter contained what the study was all about, the risks and benefits, the approval of the institution, and how long the study would take. Additionally, the researchers informed the participants that their data will be kept confidential and that they have

the freedom to stop and withdraw the information given to them.

2.11 Vulnerability of research participants

The study is into children with special needs but the participants are teachers and parents of children with special needs. Still, ethical standards should be present at all times to minimize the risk and respect the participant's rights and well-being. The Researchers ensured all data collected are confidential in accordance with the Data Privacy Act law.

2.12 Risks, Benefits, and Safety

The researchers of this study ensured the participants to not get harmed in any form, whether psychological, social, legal, or physical.

2.13 Privacy and Confidentiality

The researchers asked the participants for their responses to be transcribed and be part of the study. Even though the researchers know who the participants are, their data will not be used as the researchers will protect it (name, age, etc.) following RA 10173 or the Data Privacy Act.

2.14 Justice

Researchers ensured equal and respectful treatment of study participants while disclosing any relevant information necessary for ethical considerations in research. This underlines the importance of upholding the principle of justice.

2.15 Transparency

The researchers distributed a consent form to ensure transparency. The form provides a comprehensive explanation of their roles, the study's purpose, and any associated benefits or risks. Additionally, the form emphasized the confidentiality of personal data and reassured participants that they have the right to withdraw from the study at any time without consequences.

2.16 Qualification of the researcher

The qualification of the researcher is an important factor in ensuring the validity and credibility of the research findings. A qualified adviser will be guiding the researchers who are still students of the university to ensure the research adherence to ethical standards and to provide guidance in the development and implementation of EduCaNet.

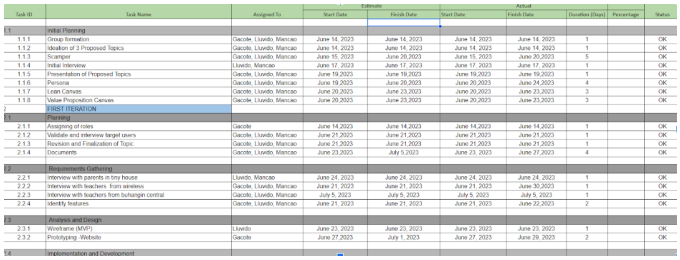
2.17 Adequacy of facility

To ensure the safety of all participants, testing and evaluating the application took place in designated areas within school premises. Researchers sent consent letters to schools that have already participated in initial validation and interviews, such as ILLC, Rizal Special Education Learning Center, Ricafi, and Buhangin Central. Efforts will also be made to include other SPED schools for testing and evaluation.

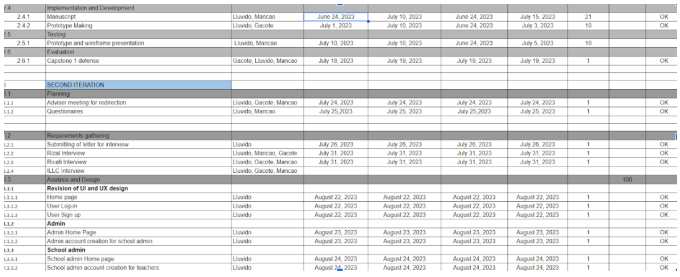
2.18 Community Development

This study aims to contribute to the community by designing a learning management system (LMS) for special education teachers working with children with special needs and their parents. Its purpose extends beyond academia, as it directly impacts the community. The researchers ensured that ethical guidelines were followed throughout the research process.

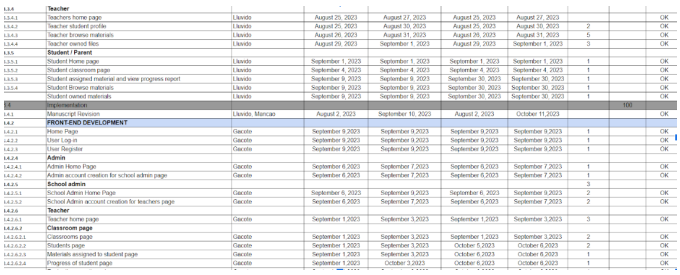
3 Work Plan



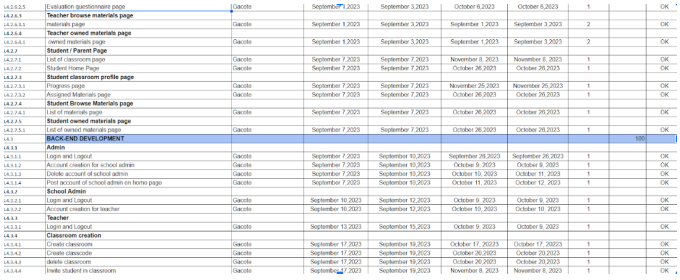
Task ID	Task Name	Assigned To	Estimate		Actual				
			Start Date	Finish Date	Start Date	Finish Date	Duration (Days)	Percentage	Status
1	Initial Planning								
1.1.1	Group formation	Gacote, Lluvido, Mancao	June 14, 2023	June 14, 2023	June 14, 2023	June 14, 2023	1		OK
1.1.2	Ideation of 3 Proposed Topics	Gacote, Lluvido, Mancao	June 14, 2023	June 14, 2023	June 14, 2023	June 14, 2023	1		OK
1.1.3	Scamper	Gacote, Lluvido, Mancao	June 15, 2023	June 20,2023	June 15, 2023	June 20,2023	5		OK
1.1.4	Initial Interview	Lluvido, Mancao	June 17, 2023	June 17, 2023	June 17, 2023	June 17, 2023	1		OK
1.1.5	Presentation of Proposed Topics	Gacote, Lluvido, Mancao	June 19,2023	June 19,2023	June 19,2023	June 19,2023	1		OK
1.1.6	Persona	Gacote, Lluvido, Mancao	June 19,2023	June 20,2023	June 20,2023	June 24,2023	4		OK
1.1.7	Lean Canvas	Gacote, Lluvido, Mancao	June 20,2023	June 23,2023	June 20,2023	June 23,2023	3		OK
1.1.8	Value Proposition Canvas	Gacote, Lluvido, Mancao	June 20,2023	June 23,2023	June 20,2023	June 23,2023	3		OK
2	FIRST ITERATION								
2.1	Planning								
2.1.1	Assigning of roles	Gacote	June 14,2023	June 14,2023	June 14,2023	June 14,2023	1		OK
2.1.2	Validate and interview target users	Gacote, Lluvido, Mancao	June 21,2023	June 21,2023	June 21,2023	June 21,2023	1		OK
2.1.3	Revision and Finalization of Topic	Gacote, Lluvido, Mancao	June 21,2023	June 21,2023	June 21,2023	June 21,2023	1		OK
2.1.4	Documents	Gacote, Lluvido, Mancao	June 23,2023	July 5,2023	June 23, 2023	June 27,2023	4		OK
2.2	Requirements Gathering								
2.2.1	Interview with parents in tiny house	Lluvido, Mancao	June 24, 2023	June 24, 2023	June 24, 2023	June 24, 2023	1		OK
2.2.2	Interview with teachers from sarwiswis	Gacote, Lluvido, Mancao	June 21, 2023	June 21, 2023	June 21, 2023	June 30,2023	1		OK
2.2.3	Interview with teachers from buhangin central	Gacote, Lluvido, Mancao	July 5, 2023	July 5, 2023	July 5, 2023	July 5, 2023	1		OK
2.2.4	Identify features	Gacote, Lluvido, Mancao	June 21, 2023	June 21, 2023	June 21, 2023	June 22,2023	2		OK
2.3	Analysis and Design								
2.3.1	Wireframe (MVP)	Lluvido	June 23, 2023	June 23, 2023	June 23, 2023	June 23, 2023	1		OK
2.3.2	Prototyping: Website	Gacote	June 27,2023	July 1, 2023	June 27, 2023	June 29, 2023	2		OK
2.4	Implementation and Development								



2.4	Implementation and Development								
2.4.1	Manuscript	Lluvido, Mancao	June 24, 2023	July 10, 2023	June 24, 2023	July 15, 2023	21		OK
2.4.2	Prototype Making	Lluvido, Gacote	July 1, 2023	July 10, 2023	June 24, 2023	July 3, 2023	10		OK
2.5	Testing								
2.5.1	Prototype and wireframe presentation	Lluvido, Mancao	July 10, 2023	July 10, 2023	June 24, 2023	July 5, 2023	10		
2.6	Evaluation								
2.6.1	Capstone 1 defense	Gacote, Lluvido, Mancao	July 18, 2023	July 19, 2023	July 19, 2023	July 19, 2023	1		OK
3	SECOND ITERATION								
3.1	Planning								
3.1.1	Adviser meeting for redirection	Lluvido, Gacote, Mancao	July 24, 2023	July 24, 2023	July 24, 2023	July 24, 2023	1		OK
3.1.2	Questionaires	Lluvido, Mancao	July 25,2023	July 25, 2023	July 25,2023	July 25, 2023	1		OK
3.2	Requirements gathering								
3.2.1	Submitting of letter for interview	Lluvido	July 26, 2023	July 26, 2023	July 26, 2023	July 26, 2023	1		OK
3.2.2	Rizal Interview	Lluvido, Mancao, Gacote	July 31, 2023	July 31, 2023	July 31, 2023	July 31, 2023	1		OK
3.2.3	Ricafi Interview	Lluvido, Gacote, Mancao	July 31, 2023	July 31, 2023	July 31, 2023	July 31, 2023	1		OK
3.2.4	ILLC Interview	Lluvido, Gacote, Mancao							
3.3	Analysis and Design							100	
3.3.1	**Revision of UI and UX design**								
3.3.1.1	Home page	Lluvido	August 22, 2023	August 22, 2023	August 22, 2023	August 22, 2023	1		OK
3.3.1.2	User Log-in	Lluvido	August 22, 2023	August 22, 2023	August 22, 2023	August 22, 2023	1		OK
3.3.1.3	User Sign up	Lluvido	August 22, 2023	August 22, 2023	August 22, 2023	August 22, 2023	1		OK
3.3.2	**Admin**								
3.3.2.1	Admin Home Page	Lluvido	August 23, 2023	August 23, 2023	August 23, 2023	August 23, 2023	1		OK
3.3.2.2	Admin account creation for school admin	Lluvido	August 23, 2023	August 23, 2023	August 23, 2023	August 23, 2023	1		OK
3.3.3	**School admin**								
3.3.3.1	School admin Home page	Lluvido	August 24, 2023	August 24, 2023	August 24, 2023	August 24, 2023	1		OK
3.3.3.2	School admin account creation for teachers	Lluvido	August 24, 2023	August 24, 2023	August 24, 2023	August 24, 2023	1		OK



3.3.4	**Teacher**								
3.3.4.1	Teachers home page	Lluvido	August 25, 2023	August 27, 2023	August 25, 2023	August 27, 2023			OK
3.3.4.2	Teacher student profile	Lluvido	August 25, 2023	August 30, 2023	August 25, 2023	August 30, 2023	2		OK
3.3.4.3	Teacher browse materials	Lluvido	August 26, 2023	August 31, 2023	August 26, 2023	August 31, 2023	5		OK
3.3.4.4	Teacher owned files	Lluvido	August 29, 2023	September 1, 2023	August 29, 2023	September 1, 2023	3		OK
3.3.5	**Student / Parent**								
3.3.5.1	Student Home page	Lluvido	September 1, 2023	September 1, 2023	September 1, 2023	September 1, 2023	1		OK
3.3.5.2	Student classroom page	Lluvido	September 4, 2023	September 4, 2023	September 4, 2023	September 4, 2023	1		OK
3.3.5.3	Student assigned material and view progress report	Lluvido	September 9, 2023	September 9, 2023	September 30, 2023	September 30, 2023	1		OK
3.3.5.4	Student Browse materials	Lluvido	September 9, 2023	September 9, 2023	September 30, 2023	September 30, 2023	1		OK
	Student owned materials	Lluvido	September 9, 2023	September 9, 2023	September 30, 2023	September 30, 2023	1		OK
4	Implementation							100	
4.0.1	Manuscript Revision	Lluvido, Mancao	August 2, 2023	September 10, 2023	August 2, 2023	October 11,2023			OK
4.4.2	**FRONT-END DEVELOPMENT**								
4.4.2.1	Home Page	Gacote	September 9,2023	September 9,2023	September 9,2023	September 9,2023	1		OK
4.4.2.2	User Log in	Gacote	September 9,2023	September 9,2023	September 9,2023	September 9,2023	1		OK
4.4.2.3	User Register	Gacote	September 9,2023	September 9,2023	September 9,2023	September 9,2023	1		OK
4.4.2.4	**Admin**								
4.4.2.4.1	Admin Home Page	Gacote	September 6,2023	September 7,2023	September 6,2023	September 7,2023	1		OK
4.4.2.4.2	Admin account creation for school admin page	Gacote	September 6,2023	September 7,2023	September 6,2023	September 7,2023	1		OK
4.4.2.5	**School admin**						3		
4.4.2.5.1	School Admin Home Page	Gacote	September 6, 2023	September 9,2023	September 6, 2023	September 9,2023	2		OK
4.4.2.5.2	School Admin account creation for teachers page	Gacote	September 6,2023	September 7,2023	September 6,2023	September 7,2023	2		OK
4.4.2.6	**Teacher**								
4.4.2.6.1	Teacher home page	Gacote	September 1,2023	September 3,2023	September 1,2023	September 3,2023	3		OK
4.4.2.6.2	**Classroom page**								
4.4.2.6.2.1	Classrooms page	Gacote	September 1,2023	September 3,2023	September 1,2023	September 3,2023	2		OK
4.4.2.6.2.2	Students page	Gacote	September 1,2023	September 3,2023	October 6,2023	October 6,2023	2		OK
4.4.2.6.2.3	Materials assigned to student page	Gacote	September 1,2023	September 3,2023	October 6,2023	October 6,2023	1		OK
4.4.2.6.2.4	Progress of student page	Gacote	September 1,2023	October 3,2023	October 6,2023	October 6,2023	1		OK



4.4.2.6.2.5	Evaluation questionnaire page	Gacote	September 1,2023	September 3,2023	October 6,2023	October 6,2023	1		OK
4.4.2.6.3	**Teacher browse materials page**								
4.4.2.6.3.1	materials page	Gacote	September 1,2023	September 3,2023	September 1,2023	September 3,2023	2		OK
4.4.2.6.4	**Teacher owned materials page**								
4.4.2.6.4.1	owned materials page	Gacote	September 1,2023	September 3,2023	September 1,2023	September 3,2023	2		OK
4.4.2.7	**Student / Parent Page**								
4.4.2.7.1	List of classroom page	Gacote	September 7,2023	September 7,2023	November 8, 2023	November 8, 2023	1		OK
4.4.2.7.2	Student Home Page	Gacote	September 7,2023	September 7,2023	October 26,2023	October 26,2023	1		OK
4.4.2.7.3	**Student classroom profile page**								
4.4.2.7.3.1	Progress page	Gacote	September 7,2023	September 7,2023	November 25,2023	November 25,2023	1		OK
4.4.2.7.3.2	Assigned Materials page	Gacote	September 7,2023	September 7,2023	October 26,2023	October 26,2023	1		OK
4.4.2.7.4	**Student Browse Materials page**								
4.4.2.7.4.1	List of materials page	Gacote	September 7,2023	September 7,2023	October 26,2023	October 26,2023	1		OK
4.4.2.7.5	**Student owned materials page**								
4.4.2.7.5.1	List of owned materials page	Gacote	September 7,2023	September 7,2023	October 26,2023	October 26,2023	1		OK
4.4.3	**BACK-END DEVELOPMENT**							100	
4.4.3.1	**Admin**								
4.4.3.1.1	Login and Logout	Gacote	September 7,2023	September 10,2023	September 26,2023	September 26,2023	1		OK
4.4.3.1.2	Account creation for school admin	Gacote	September 7,2023	September 10,2023	October 9, 2023	October 9, 2023	1		OK
4.4.3.1.3	Delete account of school admin	Gacote	September 7,2023	September 10,2023	October 10, 2023	October 10, 2023	1		OK
4.4.3.1.4	Post account of school admin on home page	Gacote	September 7,2023	September 10,2023	October 11, 2023	October 12, 2023	1		OK
4.4.3.2	**School Admin**								
4.4.3.2.1	Login and Logout	Gacote	September 10,2023	September 12,2023	October 9, 2023	October 9, 2023	1		OK
4.4.3.2.2	Account creation for teacher	Gacote	September 10,2023	September 12,2023	October 10, 2023	October 10, 2023	1		OK
4.4.3.3	**Teacher**								
4.4.3.3.1	Login and Logout	Gacote	September 13,2023	September 15,2023	October 9, 2023	October 9, 2023	1		OK
4.4.4	**Classroom creation**								
4.4.4.1	Create classroom	Gacote	September 17,2023	September 19,2023	October 17, 20223	October 17, 20223	1		OK
4.4.4.2	Create classcode	Gacote	September 17,2023	September 19,2023	October 20,2023	October 20,2023	1		OK
4.4.4.3	delete classcode	Gacote	September 17,2023	September 19,2023	October 20,2023	October 20,2023	1		OK
4.4.4.4	Invite student in classroom	Gacote	September 17,2023	September 19,2023	November 8, 2023	November 8, 2023	1		OK

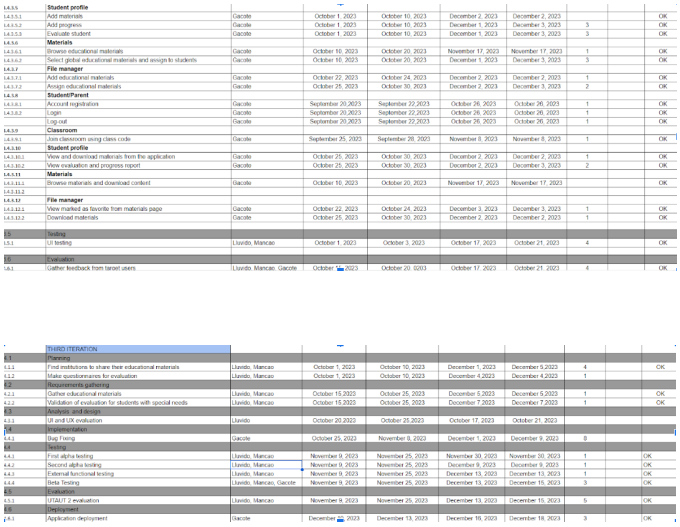


Table 10. Likert scale rating with mean range matrix

Rating	Categorical Rating	Verbal Description
5 (4.21 - 5)	Strongly Agree	I entirely agree with the statement
4 (3.41 - 4.20)	Agree	I agree with the statement
3 (2.61 - 3.40)	Neutral	I neither agree nor disagree
2 (1.81 - 2.60)	Disagree	I disagree with the statement
1 (1-1.80)	Strongly Disagree	I strongly disagree with the statement

4 Results and Discussion

4.1 Testing Results

The researchers garnered a total of 21 respondents consisting of 12 teachers, 6 parents, and 3 guardians who willingly volunteered to take part in the testing and answering the UTAUT2 survey. The Likert scale was used to evaluate the results according to the use of technology and how acceptable our application is in terms of UTAUT2 factors. The Likert scale is a rating scale that assists in measuring the intensity and attitude of responses, ranging from strongly agreeing to strongly disagreeing.

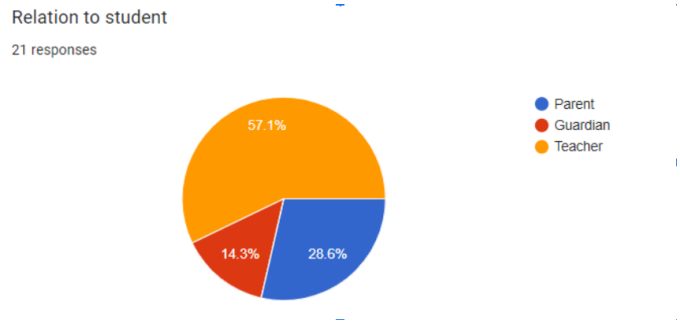


Figure 4. Percentage of respondents based on Relation to student.

The survey results were totaled to calculate the mean and standard deviation, helping to assess the outcome. The mean represents the average value of the dataset, while the standard deviation measures the dispersion of data relative to the mean. Likert scale was used to indicate the range of performance from high to low. This scale consists of five ranges: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree [56]

4.2 Functional testing of the application

Three testing sessions were conducted because bugs were discovered during the first testing. This was to ensure that all the functionalities of the application are present before testing it to the target users.

4.2.1 Testing I . After the implementation of the application, the non-programmers Allen James Lluvido and Joanne Mancao immediately tested the application's functionalities. Bugs were found on the teacher's side when assigning materials to students and adding progress reports. After the bugs were discovered, it was immediately reported to the programmer to fix them.

4.3 Testing II

For the second testing, it took 8 days to fix the bugs found in the application. Assigning materials to students and adding progress reports was fixed immediately for the teacher's side. After the bug fixing, the non-programmers tested the application and as a result, there were no more bugs found in the application.

4.4 Testing III

For the third testing, to avoid bias of the functionality of the application, the researchers let Mr. Seth Sacopayo as their external tester to test their application's functionality. All of the functionalities were marked as passed as a result. Therefore, the application is ready for testing with the target users.

4.5 Beta Testing

The beta testing spanned 3 days, during this phase the researchers visited the following educational institutions for the testing phase: The Lamb of God Sped Academy (LGSA), Wireless Elementary School, RICAFI, and ILLC. The testers

answered the UTAUT2 survey questionnaire after testing the application.

4.6 Enable teachers to establish multiple virtual classrooms

This feature was created so teachers could create virtual classrooms. During the testing phase, the researchers let the teachers make their classrooms, and based on the testing, they created virtual classrooms. At the end of the student/parent's side, the researchers let them join the classroom created by the teacher.

4.7 Allow teachers to assign learning materials based on the individual needs and progress of SPED students.

This feature was created so that teachers could assign materials based on the individual needs of SPED student/s for their skills and academic progress. During the testing phase, in the global materials section, there were materials specifically for SPED students, which the SPED teachers contributed to the researchers. The global materials were assigned to students inside the classroom created by the teachers. On the side of the student/parents, they were able to view and download the global materials assigned by the teacher. The same goes for the local materials; the teachers can upload their materials and assign them to their students based on their needs. The students/parents can view and download the local materials assigned to them by the teacher.

4.8 Integrate tools for evaluating students' progress through questionnaires, assessments, and personalized notes

This feature was created for the teachers to evaluate their SPED student progress through personalized notes or evaluation process. Before the testing phase, the researchers interviewed a SPED teacher from Wireless Elementary School, and they were given a guide on how the SPED teachers evaluate their SPED students. With the help of the sample, the researchers made their evaluation and let SPED the teacher evaluate their evaluation questionnaire. The feature was then integrated into the application, and during the testing phase, the teachers were able to evaluate the students based on their skills and academic performance. On the student/parent's side, they could view the evaluation assessed by the teacher.

4.9 Allow students and parents to explore learning materials assigned by teachers

This feature was created for the parents to view, print, and download the materials assigned by the teachers for their child. During the testing phase, the parents were able to view and download the materials assigned by the teacher. However, the materials cannot be printed during the testing phase since the testing took place within school premises, where printers are unavailable.

4.10 Provide parents with a means to view and monitor student progress

This feature was created for the parents to view and monitor the progress of their child. During the testing phase, parents viewed the progress of their kid that has been evaluated by the teacher.

4.11 Technical Findings

In the technical findings, the developer first used firebase as backend service but it does not support windows applications yet. Next choice was Appwrite but the developer was confused and did not find the service easy to use, then the developer is now settled in using pocketbase since it was easy to integrate and to manipulate.

The developer implemented pagination using the Pagination Widget or library, constructing a dynamic page structure based on data retrieved from the database. Each page showcases 5 items, with the total number of pages determined by dividing the total item count by 5. For search functionality, a filter was applied to the data retrieval process, substituting the "=" sign with " " to facilitate a term-based search utilizing the "LIKE" operator. To export progress records to a PDF file, the Flutter PDF library was employed to convert the widget into a PDF file, with the capability to open the resulting PDF utilizing an open-source library upon clicking the print button.

During the development of the Windows app using Flutter, the developer faced challenges in locating suitable libraries, given that many were primarily designed for mobile applications. Additionally, a video player library was integrated to enable the viewing of uploaded videos within the system, featuring functions such as enlargement, play/pause controls, and duration manipulation, along with the inclusion of thumbnail images for video previews. Furthermore, a file picker was implemented to streamline the selection of files from the computer.

The developer also utilized the Inno Setup Compiler to create an executable (exe) file. Prior to using this compiler, the folder containing the exe file and accompanying DLL files needed to be zipped. This unconventional method required placing the exe file in a folder for it to run. However, to enhance the installation process, the Inno Setup Compiler was employed to compile the files, allowing the exe file to run independently without the need for a separate folder.

4.12 Evaluation results of EduCaNet using UTAUT2

Parents/Guardians and Teacher's UTAUT2 evaluation results

Table 11 displays the results of the EduCaNet application regarding the user's perceptions of performance expectancy. As a result, the users strongly agree with the statements of how the application affects their performance as a teacher/parent/guardian.

Table 11. Parents/Guardians and Teacher's result of the application's Performance Expectancy (PE).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Performance Expectancy 1	I find EduCaNet useful in doing tasks as a teacher/parent/guardian.	5.00	0.00	Strongly Agree
Performance Expectancy 2	I find EduCaNet increases my chances of productivity as a teacher/parent/guardian.	4.81	0.40	Strongly Agree
Performance Expectancy 3	Using EduCaNet helps me monitor the child's educational progress and performance as a teacher/parent/guardian.	4.95	0.22	Strongly Agree
Performance Expectancy 4	UI find EduCaNet useful in accessing informative resources related to the child's special needs.	4.95	0.22	Strongly Agree

Table 12 displays the results of the EduCaNet application regarding the user's perceptions of Effort Expectancy. As a result, the users strongly agree with the statements that the application is worth the effort of using.

Table 12. Parents/Guardians and Teacher's result of the application's Effort Expectancy (EE).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Effort Expectancy 1	Learning how to use EduCaNet is easy for me.	4.71	0.46	Strongly Agree
Effort Expectancy 2	My interaction with EduCaNet is clear and understandable.	4.95	0.22	Strongly Agree
Effort Expectancy 3	I find EduCaNet to be user-friendly	4.81	0.40	Strongly Agree
Effort Expectancy 4	I find EduCaNet to be user-friendly	4.81	0.40	Strongly Agree

Table 13 displays the results of the EduCaNet application regarding the user's perceptions of Social Influence. As a result, the users strongly agree with the statements that they will use the application if influenced by colleagues or friends.

Table 13. Parents/Guardians and Teacher's result of the application's Social Influence (SI).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Social Influence 1	My colleagues and friends think that I should use EduCaNet	4.62	0.59	Strongly Agree
Social Influence 2	People who influence my behavior think that I should use EduCaNet	4.48	0.81	Strongly Agree
Social Influence 3	I would use EduCaNet if my colleagues and friends use them.	4.62	0.80	Strongly Agree
Social Influence 4	Overall, my colleagues and friends support the use of EduCaNet.	4.62	0.67	Strongly Agree

Table 14 displays the results of the EduCaNet application regarding the user's perceptions of Facilitating Condition. As a result, the users strongly agree with the statements that they possess the technologies and knowledge to use the application.

Table 14. Parents/Guardians and Teacher's result of the application's Facilitating Conditions (FC).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description

Facilitating Conditions 1	I have the resources necessary to use EduCaNet.	4.76	0.54	Strongly Agree
Facilitating Conditions 2	I have the knowledge necessary to use EduCaNet.	4.62	0.50	Strongly Agree
Facilitating Conditions 3	EduCaNet is compatible with other technologies I use.	4.57	0.75	Strongly Agree
Facilitating Conditions 4	I can get help from others when I have difficulties using EduCaNet.	4.76	0.54	Strongly Agree

Table 15 displays the results of the EduCaNet application regarding the user's perceptions of Facilitating Condition. As a result, the users strongly agree that the application brings joy and pleasure.

Table 15. Parents/Guardians and Teacher's result of the application's Hedonic Motivation (HM).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Hedonic Motivation 1	Using EduCaNet is enjoyable.	4.81	0.40	Strongly Agree
Hedonic Motivation 2	Using EduCaNet is very entertaining.	4.76	0.54	Strongly Agree
Hedonic Motivation 3	Using EduCaNet is fun.	4.71	0.64	Strongly Agree

Table 16 displays the results of the EduCaNet application regarding the user's perceptions of Price Value. As a result, the users strongly agree with the statements that the application is good for its worth.

Table 16. Parents/Guardians and Teacher's result of the application's Price Value (PV).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Price Value 1	EduCaNet is reasonably priced.	4.24	0.94	Strongly Agree
Price Value 2	EduCaNet is a good value for the money.	4.38	0.97	Strongly Agree
Price Value 3	At the current price, EduCaNet provides good value.	4.52	0.87	Strongly Agree

Table 17 displays the results of the EduCaNet application regarding the user's perceptions of Habit. As a result, the users strongly agree with the statements that they are attached using the application.

Table 17. Parents/Guardians and Teacher's result of the application's Habit (H).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Habit 1	The use of EduCaNet has become a habit for me.	4.29	0.77	Strongly Agree
Habit 2	I am addicted to using EduCaNet.	4.29	0.64	Strongly Agree
Habit 3	I must use EduCaNet.	4.57	0.60	Strongly Agree
Habit 4	Using EduCaNet has become natural to me.	4.43	0.60	Strongly Agree

Table 18 displays the results of the EduCaNet application regarding the user's perceptions of Behavioral Intention. As a result, the users strongly agree with the statements that they would use the application in months to come.

Table 18. Parents/Guardians and Teacher's result of the application's Behavioral Intention (BI).

Construct	Measure Instrument	Mean	Standard Deviation	Verbal Description
Behavioral Intention 1	I intend to use EduCaNet in the months to come.	4.52	0.75	Strongly Agree
Behavioral Intention 2	I predict I will use EduCaNet in the months to come.	4.62	0.74	Strongly Agree

Behavioral Intention 3	I plan to use EduCaNet in the months to come.	4.62	0.74	Strongly Agree
Behavioral Intention 4	In general, I plan to always use EduCaNet.	4.57	0.60	Strongly Agree

Overall, the evaluation results of the UTAUT2 survey questionnaire showed a range of 4.22 and above, which states that the users entirely agree with the statements regarding the acceptance and usability of EduCaNet learning management system. The results showed that the testers of the application are satisfied with the EduCaNet learning management system.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The Learning Management System (LMS) particularly for Special Education (SPED) has been an accessible informative resource and allows a monitoring of the student progress. The design of the application accommodates the demands of the user, who are educators, parents, and guardians. The research findings emphasize the benefits of establishing an LMS for parents/guardians of children with special needs as well as SPED teachers. This development aims to make it easier for SPED teachers and parents/guardians to access information resources and effectively track the learning progress of the child.

This study concludes that the EduCaNet, a learning management system, provides benefits aligned with the research goals.

1. Teachers can establish multiple virtual classrooms to accommodate different subjects, student groups, or teaching needs through the Add Classroom feature. This demonstrates how the teacher can effectively organize and manage the classroom, ensuring a structured and conducive learning environment.
2. Allowing teachers to assign learning materials based on the individual needs and progress of SPED students for personalized education through Assigning features. This supports tailored support and ensures that each student's unique requirements are met.
3. Integrating tools for evaluating students' progress through questionnaires, assessments, and personalized notes for comprehensive and personalized student assessment through Notes and Evaluation features which is done by the teacher accounts. This displays a more holistic understanding of each student's individual development.
4. Allowing students and parents to explore learning materials assigned by teachers fosters greater engagement and collaboration in the learning process through the Global and Local Materials feature. This transparency also enables parents to support their child's education effectively.
5. Provides parents with a means to view and monitor student progress through the Progress features. This keeps the parents informed about their child's learning progress and performance.
6. Lastly, a usability evaluation was conducted with the participants to examine usability. In the course of the study, based on UTAUT 2 questions, the researchers discovered in their analysis that the application enhances convenience in terms of its usability and simplicity of use, meeting user expectations and needs effectively.

5.2 Recommendations

The researchers and the testers of the application provide recommendations to improve the EduCaNet Learning Management System (LMS) usability, functionality, and purpose.

1. Improve User Interface (UI)
2. Mobile version for parents/children: A mobile version that will allow students/parents and teachers to access the LMS from their smartphones or tablets, providing convenience and ease of use.
3. Find more contributors for global materials: To find more contributors for global materials will help ensure that the content available on the LMS will be used by both teachers and parents/students.
4. Add notifications feature: Add a notification feature that will notify the parent/guardian of their child with special needs if a teacher adds a progress or assigns a material to the student.
5. Add an accomplished function for parents/students: Add an accomplished function, when pressed the teacher will be notified that the assigned material had been accessed by the parent/student.
6. Add security when parent/student log-in: Add a function that will send the user an OTP or an email to the parent/student for added security during the log-in process.
7. Add mechanism to import list of teachers: Add a function that enables the school admin to import a list of teachers, which will automatically create a list of teacher accounts.
8. Add import mechanism to import list of classes: Add a function that enables the school admin to import a list of classrooms, which will automatically create a list of classrooms.
9. Migrating from server to server: Add a function that will export and import the data from the server.

10. Change progress icons to graph and compare from past progress: The user should have the ability to track the child's progress through various types of graphs, such as line charts or pie charts, allowing for easy comparison with past evaluations conducted by the teacher.

6

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