CASSY: An Extensible, Activity-Centered, Ergonomically Designed Task Management and Toolkit System for School Professionals

A Thesis Proposal
Submitted to the
School of Engineering and Information Technology Education
Laguna College of Business and Arts

A Partial Requirement
for the Degree of
Bachelor of Science in Computer Science

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2nd Sem., AY 2017-2018

Chapter 1

The Problem and Its Background

Introduction

The teaching profession has been called as the noblest of all professions, for indeed, no other profession could exist without it. As such, teachers are expected to possess all the qualities and the skills needed to perform all the duties that a teacher has. This includes class management skills that help a lot in providing a permissive and stimulating atmosphere that encourages pupils to raise questions and suggest alternative solutions to problems. As such, the teacher always has many things to do: preparing and teaching lessons, preparing teaching devices, marking student output, student counseling, and a countless other things that are intended to facilitate learning.

However, recent changes in curriculums and national policies have also brought changes to the work of teachers particularly as the K-12 program under the Revised Basic Education Curriculum became effective a few years ago, as of writing. Teachers have been required not only to adjust their lessons and teaching styles to the new program but also to do countless paper works for monitoring a lot of things, such as students' proficiency in English, not to mention other mundane things that other government agencies require such as monitoring the students' BMI (body mass index), among other things. These changes added new burden to the already burdensome work of the teachers. Due to the growing workload of teachers, some have contemplated leaving the teaching profession itself. This is aside from the accompanying issues of teachers feeling underpaid and the students feeling overworked, too. Being underpaid means that some teachers have to do other things in order to augment their already small take home pay and, unwittingly, pay for their

surmounting loans, taking away from what little time they have for their families and themselves.

The issue of teachers feeling overworked is not unique to the Philippines, as teachers in other countries have also experienced similar issues. Some teachers have even avoided promotions, as ascending to higher positions potentially meant additional work. Too much workload has also affected teachers' performances in adverse ways. Because of these impacts, it is, therefore, imperative to address this issue in order to mitigate its effects on teacher performance and on education itself.

One of the things that can be used to deal with the ever-increasing workload not just of teachers but also of everyone else is time management. Some studies have linked proper time management of teachers to better teacher performance. As such, the numerous tasks of teachers can be dealt with better through time management.

Time management, however, has its drawbacks. For instance, it has been observed that as more tasks are done, even more tasks are left to do, possibly causing more stress and anxiety. On the other hand, task management can help not only in completing tasks but in accomplishing their goals as well. If time management aims for efficiency and productivity, task management aims for effectiveness and goal accomplishments. As such, task management can complement, if not replace, time management.

Many tools are already available to assist people with time management and task management. Task organizers are being sold in various stores. Likewise, in these days of automation, applications for task and time management have also been available for quite some time, as of writing. There are even apps that have been designed for use by teachers. Incidentally, many teachers already appear to have mobile phones and, at least, an access

to computers, which makes the utility of these apps even more appealing. However, some of these only feature task management features, whereas teachers' work have several dimensions. A teacher is not only an instructor: they also are managers, clerks, administrators, counselors, and other things as well. In order to accommodate such a multifaceted set of roles, a teacher might need to mix and match apps available on app stores just to have the right mix of features. However, maintaining multiple apps just for a single line of work can prove to be grueling and inconvenient. As such, it will be preferable to have a single system to manage all teacher roles in one place. This system should have everything under one application and be designed with the roles and capabilities of teachers in mind.

It is, therefore, the position of the proponents that a task management and toolkit system that is tailor-fit for teachers and other academic personnel be developed for their ever-evolving needs.

Statement of the Problem

This study aims to improve task and workflow management in the daily work of teachers, school administrators, and office personnel involved in the academic sector, hereinafter referred to as the "respondents". Specifically, the study aims to answer the following inquiries:

1) How can the daily roles, functions, and workflow of the respondents be supported by the proposed system?
2) How can the different kinds of information and resources that the respondents work with be managed using the proposed system?
3) What can be done to anticipate and adapt to changes in organizational policies, utilized information systems, and established workflows?
4) How can user habits, preferences, and feedback be considered in the design, configuration, and evolution of the proposed system?

Objectives of the Study

The main objective of the study is to create an appropriate support software for the respondents with consideration for the nature of their work as professionals in the academic sector. Toward this end, the following secondary aims need to be accomplished:

1) Implement the proposed system as a digital task and workflow management software that supports mobile and desktop devices.

2) Provide tools as plugin-based subsystems that will serve both as support software for various tasks and management activities and as sample plugins for demonstrating various functions.
3) Supply ample documentation and an accompanying plugin SDK (software development kit) to support system extensibility and guide future plugin development endeavors.
4) Create a reliable preferences editor to accept user customizations and maintain an online facility for bug report submissions, user feedback and suggestions, plugin proposals, and system updates.

Significance of the Study

This study will benefit the respondents by developing a system that can assist in the management of their workflow and provide other tools to fulfill or even automate other work-related functions as well. Likewise, the resultant system will also provide a platform for which other custom-designed tools that further increase efficiency in work can be developed through institutionally backed endeavors. As mobile devices are more commonplace than ever, the product system will extend the functionalities of these devices to provide not just communicative and entertainment functions, but task, information, and organization management functions as well.

This study will also benefit software developers who have the needs of teachers in mind by providing a platform that can host subsystems that cater to the needs of teachers and other academic professionals.

This study will also benefit the students in such a way that, if their teachers are always able to more efficiently manage their time and work, they will receive more well prepared instruction and, ultimately, a better quality of education.

This study also intends to provide education sector administrators and policy makers another choice for workflow management in both classrooms and offices.

Theoretical Framework

To create a system that caters to the needs and preferences of its intended users, it should be designed with the end-users in mind. This is dealt with in the field of human factors and ergonomics.

Human factors and ergonomics, or simply ergonomics, is defined as the study of people at work. The field got its name in 1949 when a group of interested individuals assembled in Oxford, England to discuss the topic of human performance and eventually establish the Ergonomics Research Society. Sometime later, the term *human factors* was coined in the U.S. for a society of similar purpose. Ergonomics can also be described as the study of human-machine systems, with an emphasis on the human aspect. Ergonomists study people and the way they operate equipment in the home, in commerce, in factories, and in governmental activities.[1]

[1] Mark R. Lehto and James R. Buck, *Introduction to Human Factors and Ergonomics for Engineers* (New York: Taylor & Francis Group, LLC, 2008), 2-3.

The field of ergonomics is also divided into three broad domains of specialization: *physical ergonomics,* which emphasizes physiological and anatomical characteristics of humans related to physical activity; *cognitive ergonomics,* which emphasizes mental processes that affect interactions of humans and systems; and *organizational ergonomics,* which emphasizes sociotechnical systems and organizations.[2] Teachers' work can be viewed in the respective perspectives of each domain, however, as these relate more to complex tasks and organizational interactions and policies, it will be simpler enough to deal with the cognitive and organizational domains in the design of the proposed system.

Many of the principles and suggestions learned from ergonomics can be used in designing the software intended for teachers' use. Among them are the following:

1. Eliminate unnecessary elements.
2. Simplify elements
3. Keep things natural.
4. Combine compatible elements where possible.
5. Group elements in their sequence of use.
6. Locate those elements with the most frequent use in the most favorable locations.[3]

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[2] "Definition and Domains of Ergonomics," *International Ergonomics Association* «https://www.iea.cc/whats/index.html» (Accessed on April 26, 2018).
[3] Lehto and Buck, *Introduction to Human Factors*, 97-99.

Aside from these suggestions, five usability attributes can be targeted in the design and used in software requirements validation: [4]

- Learnability
- Efficiency
- Memorability
- Errors
- Satisfaction

So far, human-centered design focuses on human needs, capabilities, and behavior. [5] However, sometimes it is not enough to focus on the user as the tasks that a certain user performs and the way these tasks are done using a piece of technology is often also dictated by the technology. By also looking at the actual tasks that the users do, the products of design will not only fit the user but should also fit the user's tasks, as well. This is the focus of activity-centered design.[6]

To complete the user experience, human behavior should also be taken into consideration, especially as human emotions have a crucial role in the human ability to understand the world and learn new things. People can more easily relate to a product, a

[4] Jakob Nielsen, *Usability Engineering* (San Diego, CA: Academic Press, 1993), 20.
[5] Donald A. Norman, *The Design of Everyday Things* revised and expanded edition (NY: Basic Books, 2013), 8.
[6] "Activity-centered design," in *Wikipedia* «https://en.wikipedia.org/wiki/Activity-centered_design» (April 22, 2018).

service, a system, or an experience when they are able to connect with it at a personal level.[7] As such, the following levels of design should also be taken into consideration:[8]

- The *visceral level* is concerned with immediate emotional impact, where the appearance, shape, form, size, texture, and feel of products matter.
- The *behavioral level* is concerned with performance and usability.
- The *reflective level* is concerned with message, culture, and the meaning of a product or its use.

Questionnaires are an economical way to gather information regarding target users. In some cases, these are used after experiments to collect subjective opinions of the experimental subjects during or subsequent to the experiment.[9]

Conceptual Framework

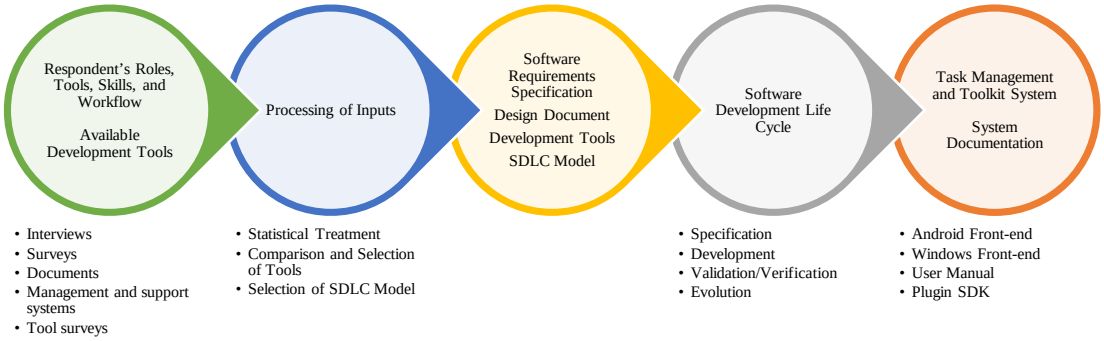

Figure 1–1 Conceptual Framework

[7] "Emotional design," in *Wikipedia* «https://en.wikipedia.org/wiki/Emotional_Design» (April 15, 2018).
[8] Donald A. Norman, *Emotional Design: Why We Love (or Hate) Everyday Things* (NY: Basic Books, 2004), 65-89.
[9] Lehto and Buck, *Introduction to Human Factors*, 414.

The paradigm in Figure 1–1 represents the logical proceeding of this study. Inputs, which comprise of respondent information and information about available development tools, will be rigorously gathered through interviews, surveys, documentary analysis, analysis of existing information systems, and software development tool surveys. Once the data are gathered, the responses in surveys will be summarized through the use of statistical treatment and rating scales. The summarized data will then be interpreted and considered in the formulation of the user requirements. Responses in interviews will also be summarized into use cases and user scenarios. Furthermore, the development tools surveyed will also be compared and tested, from which an appropriate tool set will be selected. An appropriate SDLC model will also be selected depending on contingent constraints. The software development life cycle will then commence, starting with requirements specifications, until the desired system meets the requirements.

Scope and Delimitation

This study shall focus on the roles and workflow of respondents that can be supported by different types of information systems. The respondents of the study shall include teachers, school administrators, and office personnel in the academic sector. As such, the study will also deal with administrative and clerical issues as well as instructional issues. The respondents shall also come from selected schools and offices that would agree to participate in the study.

This study will also look at existing information systems that are already in place in the school and academic settings and how these can either be replaced or adapted to interface with the proposed system. Restricted management systems may also be studied,

but the degree of liberty in doing so will depend on the authorization level that the respondents' respective parties are willing to grant to the proponents for this study.

Software development tools selection will also be dealt with in this study. The study will not look at these tools in depth. However, these tools shall be considered according to utility and practicality to the proponents.

The development cycle will also focus on creating an extensible system that can accommodate changes and additional features in the future, particularly in cases where there are changes in policies and workflows. As a corollary, an attempt to design a developer kit to address the related issue of independent plugin development shall be undertaken.

Finally, this study will initiate a cross-platform development but efforts shall be exerted for the Android and Windows desktop/UWP versions only due to hardware and software constraints on the proponents' part.

Definition of Terms

Some terms used in the study have already been defined in-text or through notes. However, this list of recurring terms with their accompanying definitions are included for further reference. The following terms are defined either nominally or operationally, whichever the case may be:

- **Academic Personnel/Academic Professional** – refers to all classroom and office personnel working in the academic/education sector, including but not limited to teachers and school heads.

- **Android** – refers to the Android OS, a mobile operating system developed by Google.[10]
- **Counseling and guidance** – the activity of a guidance counselor, a professional who counsels people, especially on personal problems and difficulties.[11] A teacher performs this role to assist students in their many and varied problems.[12]
- **DepEd** – refers to the Department of Education, a government agency in the Philippines.
- **Emotional Design** – a design perspective by Donald Norman.[13]
- **Extensibility** – refers to a system feature that allows addition of features on demand.
- **Human Factor** – refers to human characteristics, abilities, and limitations.
- **Human Factors and Ergonomics** – refers to the field of human factors and ergonomics.
- **Information System** –
- **iOS** – refers to a mobile operating system created and developed by Apple Inc. exclusively for its hardware. [14]

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[10] "Android (operating system)," in *Wikipedia* «https://en.wikipedia.org/wiki/Android_(operating_system)» (May 7, 2018).
[11] "List of counseling topics," in *Wikipedia* «https://en.wikipedia.org/wiki/List_of_counseling_topics» (March 4, 2018).
[12] Amparo S. Lardizabal, et al., *Principles and Methods of Teaching* (Quezon City: Phoenix Publishing House, Inc., 1995), 8.
[13] "Emotional design," in *Wikipedia* «https://en.wikipedia.org/wiki/Emotional_Design» (April 15, 2018).
[14] "iOS," in *Wikipedia* «https://en.wikipedia.org/wiki/IOS» (July 10, 2018).

- **Platform** – depending on context, this could refer either to the different operating systems that can host current system or to the system itself, which can host other subsystems. When taken to refer to operating systems, this includes Android and Windows.
- **Stakeholders** – refers to all people or parties that have interest in the development of the proposed system. These includes but is not limited to target users, developers of the proposed system, and research mentors.
- **UWP** – refers to the Universal Windows Platform, a platform-homogeneous application architecture created by Microsoft and first introduced in Windows 10. UWP apps are also known as Windows Store apps. UWP apps are formerly called Metro-style apps, Modern UI-style apps, and Windows 8-style apps.
- **Windows** – refers to Microsoft Windows, a graphical operating system developed, marketed, and sold by Microsoft.[15]

[15] "Microsoft Windows," in *Wikipedia* «https://en.wikipedia.org/wiki/Microsoft_Windows» (July 10, 2018).

Chapter 2

Review of Related Studies and Literature

In order to design a task management system that is tailor-fit to the needs of the respondents, it is imperative to have a fuller grasp of the issues that they deal with. As such, various materials are reviewed, ranging from various local and foreign articles to reference works. Likewise, related studies and special problems that can provide better design insight are also consulted.

The Teacher's Work

Lardizabal, et al. (1995) provides a detailed and very informative reference regarding the work and functions of a teacher, such as classroom management, planning of lessons, and evaluation of learning. According to this reference text, teachers are expected to have not only teaching, guidance, and evaluation skills, but management skills as well. Furthermore, the teacher's job is summed up in the following tasks:[16]

1. **Guiding the learning process.** The teacher should promote learning by planning and organizing meaningful learning experiences, among others.
2. **Counseling and guidance.** In performing the guidance function, the teacher uses various sources and procedures to know the pupils and their needs, works closely with the guidance counselor, and learns the techniques of individual as

[16] Amparo S. Lardizabal, et al., *Principles and Methods of Teaching* (Quezon City: Phoenix Publishing House, Inc., 1995), 8-9 (adapted).

well as group guidance. This responsibility is especially important when there is no guidance program in the school.

3. **Sponsoring extra class activities.** Extra class activities are considered part of any school program, as they are important in contributing to the development of children. Some of these activities may include student organizations, publications, athletics, speech, drama, music, and others depending on school. In assigning a teacher to any extra class activity, an administrator usually considers the teacher's interest and ability.
4. **Working with parents and the community.** The teacher's important responsibility is the establishment of harmonious relationships between the school and the community. As such, the teacher interprets his/her work and that of the school to parents by conferring with them about their children at school or at home, cooperates actively in community organizations, and participates in various PTA[17] activities and in community activities for social, economic, and political improvement.
5. **Professional responsibilities.** As a member of the teaching profession, a teacher has the responsibility to improve one's self by maintaining high standards of personal and professional conduct and by continuing to grow professionally.

[17] Parent and teacher associations.

The World Book Encyclopedia describes a teacher's job as follows:[18]

> A teacher's job involves four main duties. (1) Teachers must prepare for their classes. (2) They must guide, or assist, the learning of students. (3) They must check student progress. (4) Teachers must set a good example for their students. In carrying out these duties, teachers try to identify and respond to the needs of individual students.

Kelly (2017), a web article, also includes a list of teacher tasks organized into basic categories covering everything from planning lessons to classroom management:[19]

1. Planning, Developing, and Organizing Instruction
2. Housekeeping and Recordkeeping
3. Managing Student Conduct
4. Presenting Subject Material
5. Assessing Student Learning
6. Meeting Professional Obligations

Considering all the tasks in store for every teacher, new teachers experience some struggles at work. Llego (2017), from the TeacherPH website, lists some of them: (1) lesson plan making; (2) some administrators are making it hard for the new teacher; (3) students; (4) "I am overworked."; (5) overexpecting[20] co-teachers; and (6) "May be teaching is not for me."[21] As such, it is very clear that, even from the very beginning of a teacher's career,

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[18] Willard Abraham, "Teaching," in *World Book Encyclopedia* (Chicago, Illinois: World Book, Inc., 1990), 65-70.
[19] Melissa Kelly, "Six Daily Tasks All Teachers Should Do," *ThoughtCo.com is World's Largest Education Resource* «https://www.thoughtco.com/top-teacher-tasks-8422» (August 17, 2017) (adapted).
[20] *Sic*.
[21] Mark Anthony Llego, 'New Teachers: "The Struggle is Real.",' *TeacherPH* «https://www.teacherph.com/new-teachers-struggle-real/» (January 28, 2017) (adapted).

the teacher is always busy and even struggling with work. A teacher's work does not stop at teaching in the classroom and managing student learning: a teacher also needs to deal with co-teachers, school administrators, parents, and the community itself. Likewise, a teacher should also take care never to neglect professional obligations and continuous personal and professional development. This still does not mention all the paperwork and recordkeeping that teachers have to deal with in their work.

Teachers cover such a wide variety of tasks that related issues arise due the number of tasks they need to fulfill. For instance, in a web article, de Dios (2012) describes the predicament of underpaid and overworked teachers, who try their best to augment their income to support their family and pay their loans. The article also raises the issue's impacts on both the pupils and the educational system, as a whole:

> Public school teachers in the Philippines do not have the time, energy and money to spare. x x x
>
> ... Teachers who have to resort to additional ways to augment their income are not able to give their undivided attention to the education of the pupils in their classrooms. Both their time and attention are now compromised. On top of this, there is very little reason to be motivated, much less participate in renewing and reforming education.[22]

Another article from a news site (Clerigo 2016) also reports about a certain incident involving an overworked teacher from the Philippine DepEd of Region XI who was hospitalized after collapsing. The article reports that she finished 30 lesson plans, prepared

[22] Angel C. de Dios, "When Teachers Are Underpaid ....," *Philippine Basic Education* «http://www.philippinesbasiceducation.us/2012/07/when-teachers-are-underpaid.html» (July 5, 2012).

activities until 12:00 midnight, and skipped meals. Although the news article mentioned that the teacher allegedly skipped meals, it is still clear that she is indeed overworked and possibly sleep deprived, as well. The article also reported that a lack of teachers is also to blame for the incident.[23]

The issue of teachers having too much work not only exists in the Philippines. Various web articles from foreign sources report about this issue as well. For instance, Adams (2017) cites a report saying that young teachers are being driven out of the profession after only a few years in the job because of the demanding workload, with many of them saying the job has affected their mental health.[24] A survey (Toplikar 2007) highlights the issues of teachers having less time to do their jobs, with paperwork and record keeping adding much to their workload and stress leading some teachers to "burn out" and leave the profession.[25] Similarly, a teacher union's general secretary (Cockroft 2015) has released a statement about increased workload and bureaucracy making teaching an unappealing profession, thereby pushing some teachers to leave the profession or

[23] Evan Michael S. Clerigo, "DepEd XI warns teachers of overwork," *Davao Today* «http://davaotoday.com/main/economy/education/deped-xi-warns-teachers-of-overwork/» (July 13, 2016).
[24] Richard Adams, "Demanding workload driving young teachers out of profession," *The Guardian* «https://www.theguardian.com/education/2017/apr/15/demanding-workload-driving-young-teachers-out-of-profession» (April 15, 2017).
[25] Dave Toplikar, "Survey: Teachers overworked, lack sufficient time to plan," *LJWorld.com* «http://www2.ljworld.com/news/2007/mar/12/survey_teachers_overworked_lack_sufficient_time_pl/» (March 12, 2007).

inhibiting prospective teachers from entering.[26] Furthermore, a survey of 4382 teachers (Lover 2016) points out the following results:[27]

1. Almost a third of teachers work more than 60 hours a week, 82% stated that their workload was unmanageable, 73% said that their workload was affecting their physical health, and 76% their mental health.
2. One in five teachers intends to leave due to workload concerns.
3. One in four teachers wants to be a deputy head, but only 5% want to be a headteacher[28], for fear of increased workload and poorer work-life balance.
4. It's[29] tough to fill teaching vacancies due to a lack of good candidates.
5. The teacher shortage is already affecting children.

More than enough has been said about the plight of the overworked teachers. However, when the students are factored in, things look somewhat worse. For instance, Benn (2014) reacts to a report released by the UK's Association of Teachers and Lecturers (ATL) and posits that overworked teachers are also teaching overworked schoolchildren,

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[26] Steph Cockroft, "40% new teachers don't last a YEAR due to stress and exhaustion ATL warns," *Daily Mail Online* «http://www.dailymail.co.uk/news/article-3020255/Four-10-new-teachers-don-t-YEAR-classroom-exhausted-stressed-colleagues-says-union-boss.html» (March 31, 2015).
[27] Rachel Banning-Lover, "60-hour weeks and unrealistic targets: teachers' working lives uncovered," *The Guardian* «https://www.theguardian.com/teacher-network/datablog/2016/mar/22/60-hour-weeks-and-unrealistic-targets-teachers-working-lives-uncovered» (March 22, 2016) (adapted).
[28] *Sic.*
[29] *Sic.*

further saying, “Overtired children don’t learn.” In this light, teachers’ stress is not really the culprit but the entire system itself that requires people to do more.[30]

There are, however, some proposals that aim to alleviate the issue of overworked teachers. Local education officials, for example, suggest that every school must regulate their programs and employ schemes that will not burden the teachers.[31] Likewise, in the United Kingdom, a four-point plan is suggested (Harris 2017) to address issues in four key areas that school administrators need to look at so as to reduce the longer and longer hours of work faced by teachers:[32]

1. Every school needs to know the direction it is going in, and this needs to be understood by every member of staff.
2. Planning and assessment needs to be radically reduced.
3. Marking should never be for the benefit of the senior staff or the parents. It’s to move children’s work.
4. Meetings should be restricted to just two evenings a week and their relevance needs to be recognised.

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[30] Melissa Benn, “Education’s culture of overwork is turning children and teachers into ghosts,” *The Guardian* «https://www.theguardian.com/commentisfree/2014/apr/16/culture-overwork-teachers-children-ghosts-schools» (April 16, 2014).

[31] Evan Michael S. Clerigo, “DepEd XI warns teachers of overwork,” *Davao Today* «http://davaotoday.com/main/economy/education/deped-xi-warns-teachers-of-overwork/» (July 13, 2016).

[32] Colin Harris, “‘Stop killing teachers with planning and marking’,” *Tes - Education Jobs, Teaching Resources, Magazine & Forums* «https://www.tes.com/news/school-news/breaking-views/retain-our-best-teachers-we-need-stop-killing-them-planning-marking» (March 1, 2017).

The Department of Education (DepEd) also continuously updates its policies whenever the need arises. One of these is related to the issuing of a department order (DO 9, s. 2005) that provides measures to lessen activities that take teachers and students away from the classroom, maximize the use of the time allotment for every subject, and reduce the non-teaching duties of teachers. It also reiterates the policy that the prescribed 205 school days shall be strictly spent on engaged time-on-task and any school day or part of a school day spent otherwise is classified as a disruption.[33] Another measure to improve the tasks of teachers is embodied in a department memorandum (DM 60, s. 2015) that provides for the use of electronic class records, which afforded easy computation of total and average scores.[34]

To sum up, the importance of teachers' work can never be underscored enough despite being a potential cause of burdensome work. However, to mitigate the impact of teachers' work to themselves, to their students, and to the education system as whole, steps should be taken by authorities and policy changes should be put in place. Aside from these government- or institution-backed initiatives, it has also been suggested by various studies and literature that teachers can also benefit through time management and task management.

[33] DO 9, s. 2005, *Instituting Measures to Increase Engaged Time-on-Task and Ensuring Compliance Therewith.*
[34] DM 60, s. 2015, *Provision of the DepEd Electronic Class Record Template.*

Time Management and Task Management

Time management and task management are two entirely different things that have somewhat similar goals. Therefore, it might be helpful if the two are first defined according to various sources before being compared.

Wikipedia defines time management as follows:

> Time management is the process of planning and exercising conscious control of time spent on specific activities, especially to increase effectiveness, efficiency or productivity. x x x
>
> It is a meta-activity with the goal to maximize the overall benefit of a set of other activities within the boundary condition of a limited amount of time, as time itself cannot be managed because it is fixed. Time management may be aided by a range of skills, tools, and techniques used to manage time when accomplishing specific tasks, projects, and goals complying with a due date.[35]

Sima (2017) defines Time Management as "the process of planning and organizing how much time you spend on specific tasks, projects or goals. It involves taking conscious control over how long you spend engaged in any given activity in order to become more effective and more productive."[36]

On the other hand, Wikipedia defines task management as the process of managing a task through its life cycle. It involves planning, testing, tracking, and reporting. Effective task management requires managing all aspects of a task, including its status, priority, time, human and financial resources assignment, recurrence, dependency, notifications and so

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[35] "Time management," in *Wikipedia* «https://en.wikipedia.org/wiki/Time_management» (April 19, 2018).
[36] Laura Sima, "Time Management & Task Management: Key Differences," *Teamweek Blog* «https://teamweek.com/blog/2017/10/time-management-vs-task-management/» (October 26, 2017).

on. Task management may form part of project management and process management and can serve as the foundation for efficient workflow in an organization. Project managers adhering to task-oriented management have a detailed and up-to-date project schedule, and are usually good at directing team members and moving the project forward.[37]

Sima (2017) defines Task Management as "the process of managing a task through different stages: planning, development, and completion. It works both on an individual and on a group level by getting people to accomplish their goals."[38]

As can be seen from the definitions, time management and task management both aims for efficiency and effectiveness. However, there are clear differences. According to Sima (2017), time management works on the assumption that, if you learn to spend your time correctly, you will get more things done.[39] However, as more things are done, more work awaits. This can result to over scheduling, divided attention, stress, and an overall decrease in effectiveness. With task management, a task is simply "a piece of work that needs to be undertaken... Task management is the process of managing a task. It works both on an individual and on a group level by getting people to accomplish their goals."[40] Besides, tasks "come with clear limits which make them easier to manage," whereas time, "because it's large and clearly undefined, [it] is way more difficult to manage."[41]

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[37] "Task management," in *Wikipedia* «https://en.wikipedia.org/wiki/Task_management» (April 6, 2018).
[38] Sima, "Time Management."
[39] *Ibid.*
[40] *Ibid.*
[41] *Ibid.*

Likewise, Ravenscraft (2015) points out that although time management helps get more things done, "the result of getting more done is often having even more to do." As such, he proposes: "Rather than try to cram as much as possible into one day, focus on managing your tasks first, then dole out your time."[42]

Even though task management has been proven in the foregoing paragraphs to be superior to time management, the significance of time management still cannot be diminished, particularly in setting priorities. Various web articles provide many tips by which tasks can be more effectively done while using time more efficiently. BusinessTips (2017) proposes 10 tips for better time management while also suggesting that urgent but not so important tasks may be delegated to focus on the important tasks:[43]

1. Decide what tasks must be prioritized and do them first.
2. Focus on one task at a time.
3. Get rid of all possible distractions.
4. Manage tasks in collective groups.
5. Know your deadlines.
6. Do not linger on details too much.
7. Delegate.
8. Give yourself some break time after finished task.

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[42] Eric Ravenscraft, "Focus on Task-Management, Rather than Time-Management, to Be Less Busy," *Lifehacker* «https://lifehacker.com/focus-on-task-management-rather-than-time-management-1719924368» (July 24, 2015).

[43] "10 Tips For Better Time Management," *Business Tips Philippines*, ed. BusinessTips «https://businesstips.ph/10-tips-for-better-time-management/» (September 5, 2017) (adapted).

9. Sleep around 7 to 8 hours a day.
10. The last and most important is to be committed.

According to Madsen (2015), "Not only does effective time management allow you to get better results at work, it also helps you withstand stress and live a more fulfilling life outside of work." She also suggests seven essential time management strategies:[44]

1. Start your day with a clear focus.
2. Have a dynamic task list.
3. Focus on high-value activities.
4. Minimize interruptions.
5. Stop procrastinating.
6. Limit multi-tasking.
7. Review your day.

Cox (2014) directly gives teachers some tips on time management:[45]

1. **Ask for Help.** To save time that can be used for something more productive.
2. **Prioritize.** Teachers should prioritize to keep on track when something unexpected occurs.

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[44] Susanne Madsen, "7 Essential Time Management Strategies," *LiquidPlanner* «https://www.liquidplanner.com/blog/7-essential-time-management-strategies/» (February 16, 2015) (adapted).
[45] Janelle Cox, "Time Management Tips for Teachers," *TeachHub* «http://www.teachhub.com/time-management-tips-teachers» (2014) (adapted).

3. **Give Homework.** Leaving all of the assignments that relate to practice for homework helps clear up extra time in class for those important lessons.
4. **Organize Everything.** A well-maintained classroom runs on its own.
5. **Plan for Transition Times.** Quick, five-minute activities for transitions help save time.
6. **Maximize Lesson Planning.** Use apps or go to websites that have lesson ideas already planned.

Cox also suggests the following additional ideas for classroom management that can also help save time:[46]

- Pull out all materials needed for a lesson the day before and keep them together in a tote.
- Make transparencies for all directions to activities.
- Assign a student assistant to help pass out papers and materials.
- Place all materials that need to go to the office in one container so you only make one trip.
- Use apps to help your grading go faster.
- Create a bulletin board for roll call and lunch count that students can complete themselves.
- Divide paperwork into categories: To do, to read, to hold, to grade, etc.

[46] *Ibid.*

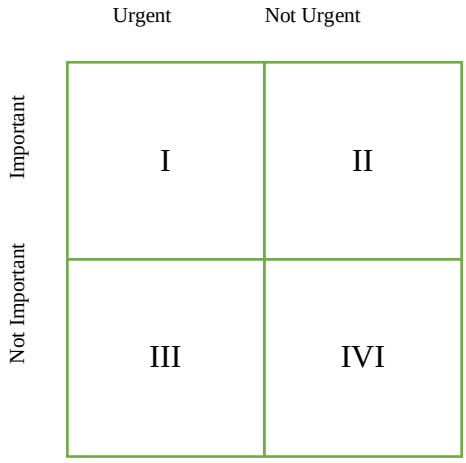

Figure 2–1 Time Management Matrix

Savara (2018) poses a question about highly productive people: "how were they able to prioritize their work quickly, and get the most done?" He goes on to propose Stephen Covey's time management matrix[47] (see Figure 2–1), also called the Eisenhower method,[48] which makes it easy to figure out what you "need" to be doing with your time and attention. Quadrant 1 represents important, urgent items that **need to be dealt with immediately.** Quadrant 2 represents important, but not urgent items that are important but do not require your immediate attention, and **need to be planned for.** Quadrant 3 represents urgent but unimportant items, which **should be minimized or eliminated.** Quadrant 4 represents trivial time wasters, unimportant items that are also not urgent which

[47] Stephen Covey, *The 7 Habits of Highly Effective People: Restoring the Character Ethic* (New York: Rosetta Books, LLC, 2012), adapted from Part II, Habit 3.
[48] "Time management," in *Wikipedia.*

don't have to be done anytime soon, perhaps add little to no value, and also **should be minimized or eliminated.**[49]

For task management, Sima (2017) offers the following tips for task management:[50]

1. **Prioritise** to make sure that important things get seen to right away. This works for both time management and task management.
2. **Do the hardest task first.** Getting down to the thing you dread the most will help you cut procrastination. In addition, completing important work will allow you to feel that you have made progress. It can also provide a push for getting more done.
3. **Use the appropriate tools** to manage your tasks as effectively as possible.

Cooper (2015), from her research through a Reddit discussion, also suggests the following methods for task management:[51]

1. **Tag tasks with a time allotment.** Tags add a context, time allotment sets a definite deadline.
2. **Start every day with a new piece of paper.** This adds focus and keeps to-do lists short.
3. **Focus on your current task, covering up the others.** This helps focus on current task.

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[49] Sid Savara, "Time Management Matrix by Stephen Covey – Urgent vs Important," *Sid Savara* «https://sidsavara.com/coveys-time-management-matrix-illustrated/» (March 11, 2018).
[50] Sima, "Time Management."
[51] Belle Cooper, "8 Time-Tested Task Management Methods," *Zapier* «https://zapier.com/blog/best-task-management-method/» (May 12, 2015).

4. **Contrast long- and short-term goals.** This includes “Year Milestones”, “Month Milestones”, and “Weekly Tasks”.
5. **Make use of Markdown.** Markdown is a type of markup language. It can also be used to organize tasks with tags.
6. **Combine flexible tools.** It helps in filling gaps in the workflow.
7. **Pony up and pay for a robust tool.** A non-free tool often has a lot of features.
8. **Regularly reflect on completed tasks.** This aids in setting goals and priorities.

Another form of time management that humans can benefit learning from is the way processors handle tasks. CPU scheduling affords computers a way to manage different tasks and keeping the CPU busy as possible while maintaining the fair allocation of its resources. GeeksforGeeks (2017) lists the different scheduling algorithms, some of which might mimic real-life task management.[52] These may be used to suggest optimal ways by which a person might go about in performing tasks.

- **First Come First Serve (FCFS):** Schedules according to arrival times of processes.
- **Shortest Job First (SJF):** Processes that have the shortest burst time are scheduled first.
- **Shortest Remaining Time First (SRTF):** A preemptive mode of SJF algorithm in which jobs are scheduled according to the shortest remaining time.

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[52] “Operating System | Process Management | CPU Scheduling,” *GeeksforGeeks* «https://www.geeksforgeeks.org/gate-notes-operating-system-process-scheduling/» (October 24, 2017) (adapted).

- **Round Robin Scheduling:** Each process is assigned a fixed time in cyclic way.
- **Priority Based scheduling (Non Preemptive):** Processes are scheduled according to their priorities, i.e., highest priority process is schedule first. If priorities of two processes match, then schedule according to arrival time.
- **Highest Response Ratio Next (HRRN):** Processes with highest response ratio are scheduled. This algorithm avoids starvation.
- **Multilevel Queue Scheduling:** Processes are placed in different queues according to the priority of process. Generally, high priority process are placed in the top-level queue. Only after completion of processes from top-level queue, lower level queued processes are scheduled.
- **Multilevel Feedback Queue Scheduling:** It allows the process to move in between queues to separate processes according to the characteristics of their CPU bursts. If a process uses too much CPU time, it is moved to a lower-priority queue.

Task Management Software in the Market

The following is a list of 12 good task management apps for teaching.[53]

1. Microsoft To-Do
2. Things 3
3. Wunderlist

[53] Educatorstechnology, "12 Good Task Management Apps for Teaching," *Educational Technology and Mobile Learning* «https://www.educatorstechnology.com/2017/06/12-good-task-management-apps-for.html» (June 3, 2017) (adapted).

4. Totoist
5. Google Keep
6. Any.do
7. Simpli
8. TickTick
9. Workflow
10. Trello
11. Remember The Milk
12. Google Calendar

The apps mentioned appear very functional and has very useful features, however, none are specifically designed for teachers. Various apps for teachers can also be found in software app stores; however, these appear to be very specialized for use by teachers only. Likewise, extensibility is quite rare.

Related Studies

Various studies and special problems were reviewed in order to gain further insight about time and task management, stress, work, classroom management, recordkeeping, and mobile app development, among others.

Mingoa (2017) is a published local study that explores the stress level, vulnerability to stress, and the most common sources of stress, and the coping strategies of teachers. It has found that the top five most common sources of stress for teachers includes: (1) having too much paperwork; (2) high cost of living; (3) insufficient salary; (4) oversized classes; and (5) being too busy, although a combination of work-related, personal, and economic

factors are at play. Additionally, having too much paperwork can possibly be a consequence of oversized classes. The study has found out that the teachers' stress levels and vulnerability to stress are relatively high. It has also found that the most common ailments the teachers in the study complain about are: (1) fatigue; (2) aching neck and shoulder muscles; (3) lower back pain; (4) sleep disturbances and insomnia; and (5) migraine headaches and menstrual distress or irregularities. Complaints on aching neck and shoulders and lower back pain are associated with the nature of the work. Coping strategies include: (1) watching television; (2) windows shopping at malls; (3) watching sports on television; (4) going to movies; and (5) doing deep breathing and relaxation exercises. Although the methods mentioned are positive, most are sedentary.[54]

The foreign study, Sahito, et al. (2016), explores and investigates the importance of time management in the professional life of teachers and the performance of the students. It uses a qualitative research design to collect data from the sample through interviews. The proponents compared public schools and private schools in their locale and found the performance of students in the private schools better because of better time management and good system of planning lessons.[55]

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[54] Thelma Rabago-Mingoa, "Filipino teachers' stress levels and coping strategies," *DLSU Research Congress 2017* «http://www.dlsu.edu.ph/conferences/dlsu-research-congress-proceedings/2017/LLI/LLI-I-020.pdf» (June 20-22, 2017).

[55] Zafarullah Sahito, et al., "Teachers' Time Management and the Performance of Students: A Comparison of Government and Private Schools of Hyderabad, Sindh, Pakistan," *World Journal of Education* 6, no. 6 (December 12, 2016): 42-50.

Khan, et al. (2016) is another foreign study that aimed to explore the relationship of time management with teacher's performance:

> This study was conducted to measure the relationship with teachers' time management techniques and their class performance... A positive relationship between teachers' time management techniques and their class performance was found. The study also inferred that teachers' lesson planning technique were very effective for their class performance due to affective time management. It was recommended that time management skills may be included in teacher training programmes to improve teachers' managerial and administrational activities.[56]

It is also interesting to know that Khan, et al. also reflected on why the most important tasks should be prioritized:

> In managing the time, prioritizing the daily tasks is also an effective method of time handling. For this purpose, one should have to separate and categorize his all activities according to their importance. It is more suitable to handle less important tasks intermittently in order to complete the major tasks... For most important tasks, suggestion is that do them in your best time. The reason for this is quite clear. This is because most important task requires more energy and the less important tasks require less energy or to finish the intended goals.[57]

The preceding studies show that teachers indeed have a lot of work on their hands that, when combined with personal and economic factors, can cause them a lot of stress and health issues that come along with it. Teachers are able to cope with stress; however, valuable strategies like time management can help teachers and even the classes they teach have better performance.

Several unpublished studies and special problems were also reviewed:

Ros (2016) is a study that aimed to develop an Android-based college planner that is customized for college students. It also aimed to integrate different organizational apps

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[56] Hafiz Muhammad Ather Khan, et al., "Exploring Relationship of Time Management with Teachers' Performance," Bulletin of Education and Research 38, no. 2 (December 2016): 249-63.
[57] *Ibid.*

in order to provide additional features related to scheduling. The application was tested successfully according to overall ease of use, user interface design, satisfaction, and usefulness. The study pointed out that there are underlying problems with the use of paper planners in terms of efficiency. Creating a software version of the paper planner would obviously afford more features for the user. The features added allowed a user to: (A) create a list of instructors and a timetable of consultation schedule; (B) create a list of courses taken for the semester; (C) record the number of absences for each course; (D) create a note for each course; (E) create a photo note taken from camera or gallery for each course; (F) create a task/to-do-list for each course; and (G) import, export, and Bluetooth transfer of a database file.[58] Of all the features listed, the task list is the main feature. This can be used to create a task for every course. There would be three lists where tasks would go, depending on marked status: upcoming, late, and completed tasks. The student can filter the tasks by course, due date, weight (assignment, exam, quiz, group meeting, etc.), or priority. Once a task is completed, the students must then mark it as done. The users can also view a status bar and setup an app widget for easier access.[59]

Garcia & Lapitan (2012) to develop a personalized and user-friendly Android application that will improve the organization of tasks of users by employing a modified Earliest Deadline First Scheduling Algorithm to handle cases with same deadline tasks. The application should also be able to generate a schedule either manually or automatically based on user input and task deadlines:

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[58] Donne Lorenzo C. Ros, "Android-Based College Planner," (special problem, Institute of Computer Studies Reading Center at the University of the Philippines - Los Baños, June 2016).
[59] *Ibid.*

> Time management has always been a problem especially for most students as they often tend to forget, cram, or fail to finish up a given task. Using the most common belonging of students, a mobile phone, an application that would serve as an aid to the time management problem will be developed. The application is to be developed specifically for smartphones running on Android OS and through the Earliest Deadline First algorithm, tasks would be scheduled and viewed in a tabular form. With the user being able to visualize the weight of his workload and notified of his upcoming tasks, it is expected that there would be a lesser risks of time management problems and tasks left unfinished.[60]

Aside from a choice between manual and automatic schedule generation, the system also features a tabular schedule generation, showing schedules generated manually or automatically. Different colors signify the differences in priorities or difficulties of each task. As the proponents recognized that proper time management is the key to keeping in sync with one's daily activities, they have suggested that a way to achieve proper time management is through task scheduling[61], similar to how computers manage CPU time for running tasks. If tasks are treated like OS tasks, existing algorithms for task scheduling can be used for schedule generation. However, they also note that, as of the time of their writing, there is not much literature available for scheduling real-world tasks. They also note that applications, both in the mobile devices and over the internet, are available for this need, although there are not enough documentation on which algorithm they used and how they are developed.[62] As such, the proponents imply that there is a lot to be desired when it comes to the use of algorithms in real-world tasks.

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[60] Jehaziel Jeiel A. Garcia and Fermin Roberto Lapitan, "SKEDGEN: An Android Task Scheduling Application Using the Modified Earliest Deadline First Algorithm" (special problem, Institute of Computer Studies Reading Center at the University of the Philippines – Los Baños, April 2012).
[61] *Ibid*, Background of the Study.
[62] *Ibid.*

Garcia & Gocoyo (2016) states that "Information has now attained its rightful place as a strategic resource... x x x Information is very decisive in any and whatever decision-making an organization has to make in dealing with all the transactions that are transpiring inside and within its bound..."[63] One of the decisions that a university needs to make is the class schedule. As such, it presents a system that can be used in class scheduling in a university. It makes use of Genetic Algorithms (GAs) combined with the Queen Bee Algorithm (QBA) for a more efficient and effective scheduling.[64] In generating the specifications of the scheduling system, the hard and soft constraints that could affect the scheduling are first determined. These includes University policies, instructors' preferences, the number of classrooms, and the total number of students. Significant features have been added such as allowing users to print or download a specific schedule in PDF format, to merge classes, to manage rooms and building, to detect class schedule conflicts, manage room types, assign faculty, and manage subject specialization.[65] The proponents of the study have used several frameworks and development tools which include NGINX for the server side, Silex PHP as the primary programming tool and back-end software, Semantic-ui and uikit for the front-end, and AngularJS via AJAX and JSON for communicating with the current system's Application Programming Interface (API).[66]

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[63] Shiela Garcia and Marie Gocoyo, "Batangas State University Enhanced Automated Class Scheduling System Using Modified Genetic Algorithms (Gas)" (master's thesis, Foster Wheeler Library at Batangas State University – Alangilan Campus, May 2016), 1.
[64] *Ibid,* vi-vii.
[65] *Ibid,* 5.
[66] *Ibid.*

Comia, et al. (2013) develops a class record for Android to help the instructors manage their class records based on their desired strategy. The system provides student profiles for the ease of access in student's information. The application also affords both a seat plan view and a recitation view. It also allows an efficient way of recording and computing student grades as opposed to manual recording and calculation. To proceed with the development, the proponents first surveyed for other similar systems and analyzed their design and development according to interface and the database management components. After implementation, the system is then evaluated according to functionality, compatibility and user acceptance.[67]

In the foregoing special problems, different issues such as time management, task planning, class scheduling, and class record maintenance are all addressed through Android-based or mobile-device-based apps. The developers all look to the currently commonplace smartphones as functional management tools. All apps feature at least a sort of automation, especially in generating schedules or maintaining records. Each app also affords different views of the same information and different ways in manipulating them. Some of these studies have carried out surveys of similar systems in order to analyze their design and development. The apps are also evaluated after their implementation. However, it will be interesting to note that, in the design endeavors, CPU scheduling algorithms are considered for scheduling real-life tasks and special algorithms describing real-life, naturally-occurring events or processes, such as genetic algorithms and the queen bee

[67] Lysa V. Comia, Mary Grace M. Manalo, and Reena A. Silva, "Design and Development of a Mobile Class Record Android Application" (baccalaureate's thesis, Foster Wheeler Library at Batangas State University – Alangilan Campus, March 2013).

algorithm, are applied to automation. Another thing worth mentioning is how the developers paid attention to personal, organizational, and activity-related factors in the design of their respective systems.

Regarding development tools, a list of frameworks on the web can be found at the page Mobile Frameworks Comparison Chart (n.d.).[68] Many frameworks and development tools are listed, but the proponents of the current study deem Xamarin as a very suitable option, particularly as Xamarin can be used with Visual Studio and C# to produce apps that can target Android, iOS, and Windows UWP (Universal Windows Platform) while sharing code among the different platform implementations. However, there are other tools that might still be worthy of consideration during the design phase of this study, such as Google's Android Studio and Embarcadero's RAD Studio.

In order to select the best framework for the purposes of the proponents, the proponents also reviewed the suggestions of Srivastav (2015). The article points out the importance of choosing the programming language that the programmers prefer especially when there are time constraints. Likewise, the user interface, the UX, and the responsiveness of a resulting app should also be another consideration in choosing the appropriate framework particularly as these can directly affect the app structure, usability, and overall user experience. Finally, a framework that has ample documentation and a large community of developers can provide more benefits than a framework that has otherwise.[69]

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[68] "Mobile Frameworks Comparison Chart", «http://mobile-frameworks-comparison-chart.com/» (Accessed April 30, 2018).
[69] *cf.* Shivam Srivastav, "How To Choose The Best Framework For Your Mobile App?," *Appinventiv Official Blog for Mobile App Development* «https://appinventiv.com/blog/choose-best-framework-mobile-app» (August 13, 2015).

Plugin-Based Architecture

As the proponents are planning to create an extensible system, a plugin-based architecture will be most suitable as the system's main architecture. According to Paul (2011), a plugin architecture app has three components: (1) the plugin container, (2) the plugin interface, and (3) the plugins. The plugin-enabled application also provides the following flexibilities: (1) reduced size in initial deployment; (2) incrementing the modules as plugins; and (3) customers can be benefitted by choosing plugin modules, thus, reduction in cost.[70]

Ergonomic Design and Emotional Design

In designing a system that is meant to fit the needs and characteristics of target users, it is very important to first understand the user. This is the role of ergonomic design.

The website of the International Ergonomics Association defines ergonomics as "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance." It also identifies three domains of specialization:[71]

- **Physical ergonomics** is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity.

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[70] Jean Paul, "Creating a Plugin enabled Application: Part 1 of 2," *C# Corner* «https://www.c-sharpcorner.com/uploadfile/40e97e/creating-a-plugin-enabled-application-part-1-of-2/» (May 4, 2011).
[71] "Definition and Domains of Ergonomics," *International Ergonomics Association* «https://www.iea.cc/whats/index.html» (Accessed on April 26, 2018).

- **Cognitive ergonomics** is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system.
- **Organizational ergonomics** is concerned with the optimization of sociotechnical systems, including their organizational structures, policies, and processes.

Wikipedia defines Human Factors and Ergonomics as the application of psychological and physiological principles to the engineering and design of products, processes, and systems. The term "human factor" is a physical or cognitive property of an individual or social behavior specific to humans that may influence the functioning of technological systems. When taken to refer to the field, the terms "human factors" and "ergonomics" are often used interchangeably. The goal of human factors is to reduce human error, increase productivity, and enhance safety and comfort with a specific focus on the interaction between the human and the thing of interest. In essence, it is the study of designing equipment, devices, and processes that fit the human body and its cognitive abilities. It accounts for the user's capabilities and limitations in seeking to ensure that the tasks, functions, information, and the environment suit that user. Some of the methods for evaluation of human factors include ethnographic analysis, focus groups, surveys and questionnaires, task analysis, user analysis, time studies, cognitive walkthrough, and HITOP (High Integration of Technology, Organization, and People), among others.[72]

[72] "Human factors and ergonomics," in *Wikipedia* «https://en.wikipedia.org/wiki/Human_factors_and_ergonomics» (April 18, 2018).

In the book, *Introduction to Human Factors and Ergonomics for Engineers* (Lehto and Buck 2008), ergonomics was defined as the study of people at work. The field got its name in 1949 when a group of interested individuals assembled in Oxford, England to discuss the topic of human performance. The group decided to adopt the term ergonomics from the Greek words *ergos* (work) and *nomos* (natural law) and called themselves the Ergonomics Research Society. Sometime later, the term *human factors* was coined in the U.S. for a society of similar purpose. Ergonomics can also be described as the study of human-machine systems, with an emphasis on the human aspect. Ergonomists study people and the way they operate equipment in the home, in commerce, in factories, and in governmental activities.[73]

Lehto & Buck (2008) also identify some traditional principles in ergonomic design:[74]

1. Eliminate unnecessary elements. Unnecessary design features add to the cost of the design without benefitting the user.
2. Simplify elements. Simple solutions to a design problem are elegant because they satisfy the need at lower cost and frequently produce longer life cycles.
3. Keep things natural. Natural activities are compatible because people intuitively avoid actions that feel awkward.

[73] Mark R. Lehto and James R. Buck, *Introduction to Human Factors and Ergonomics for Engineers* (New York: Taylor & Francis Group, LLC, 2008), 2-3.
[74] *Ibid*, 97-99.

4. Combine compatible elements where possible. Combining activities can often improve operations, provided that the activities being combined are compatible.
5. Group elements in their sequence of use. Revise operational sequences to reduce incompatibilities between successive activities.
6. Locate those elements with the most frequent use in the most favorable locations. Keep the flow of work moving long smooth curves over space, minimizing backtracking, extra movement, delays, and needless inventory.

In many cases, the designer needs to determine the attitudes, concerns, objectives, and goals of various subpopulations of people on the use of a particular product. In most cases, the questionnaire can be used to gather such information economically. In other cases, questionnaires are used after experiments to collect subjective opinions of the experimental subjects during or subsequent to the experiment.[75]

Nielsen (1993) defines five usability attributes: learnability, efficiency, memorability, errors, and satisfaction. He also identifies ten usability principles that should be followed by all user interface designers. These are as follows:[76]

1. Simple and natural dialogue
2. Speak the users' language
3. Minimize the users' memory load
4. Consistency

[75] *Ibid*, 414.
[76] Jakob Nielsen, *Usability Engineering* (San Diego, CA: Academic Press, 1993), 20.

5. Feedback
6. Clearly marked exits
7. Shortcuts
8. Good error messages
9. Prevent errors
10. Help and documentation

In formulating preference tests, Karlin (as cited in Lehto & Buck, 2008) provides many practical suggestions in order to determine what customers wanted:[77]

1. Preferences and opinions from people without actual use experience are unreliable.
2. Users should try out equipment under normal, real-life conditions in order to find out what their preferences really are.
3. Initial preference opinions based on brief experience with the product may be reversed by subsequent experience.
4. Many people have preconceived biases. Experience with a new device should be extensive enough to overcome those biases, enabling the user to evaluate all of its important properties.
5. Experience with a new device should duplicate the field situation as closely as possible.

[77] Lehto & Buck, *Introduction to Human Factors*, 554.

6. People cannot artificially generate or imagine needs that are not real. Users should not be expected to ignore certain features in an experimental device that the tested experimental device does not possess but which would be present in the planned future device.
7. Users in an experiment should be allowed to use the device the way they want to use it.

Norman (2013) proposes human-centered design:

> … an approach that puts human needs, capabilities, and behavior first, then designs to accommodate those needs, capabilities, and ways of behaving. Good design starts with an understanding of psychology and technology. Good design requires good communication, especially from machine to person, indicating what actions are possible, what is happening, and what is about to happen... Designers need to focus their attention on the cases where things go wrong, not just on when things work as planned. xxx
>
> Human-centered design is a design philosophy. It means starting with a good understanding of people and the needs that the design is intended to meet. This understanding comes about primarily through observation, for people themselves are often unaware of their true needs, even unaware of the difficulties they are encountering.[78]

Wikipedia also provides some insight on Activity-centered design, an extension of the Human-centered design paradigm in interaction design. ACD features heavier emphasis on the activities that a user would perform with a given piece of technology. When working with activity-centered design, the designers use research to get insights of

[78] Donald A. Norman, *The Design of Everyday Things* revised and expanded edition (NY: Basic Books, 2013), 8.

the users. Observations and interviews are typical approaches to learn more about the user's behavior.[79]

Emotional design is concerned with how emotions have a crucial role in the human ability to understand the world and how they learn new things. Emotional design is an important element when generating ideas for human-centred opportunities. People can more easily relate to a product, a service, a system, or an experience when they are able to connect with it at a personal level.[80]

Norman (2004) suggests considering human emotions for design. He proposes three levels of design, which form the foundation of emotional design:[81]

1. **Visceral design** - all about immediate emotional impact, where the appearance, shape, form, size, texture, and feel of products matter.
2. **Behavioral design** - all about use, where appearance and rationale doesn't matter but performance does; the focus of practitioners in the usability community.
3. **Reflective design** - all about message, culture, and the meaning of a product or its use. For one, it is about the meaning of things, the personal remembrances something evokes. For another, very different thing, it is about self-image and the message a product sends to others.

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[79] "Activity-centered design," in *Wikipedia* «https://en.wikipedia.org/wiki/Activity-centered_design» (April 22, 2018).
[80] "Emotional design," in *Wikipedia* «https://en.wikipedia.org/wiki/Emotional_Design» (April 15, 2018).
[81] Donald A. Norman, *Emotional Design: Why We Love (or Hate) Everyday Things* (NY: Basic Books, 2004), 65-89.

Technology is developed to afford its users better ways of doing things. However, to fully achieve this goal, technology should be designed according to its target users' needs, preferences, tasks, abilities, and, possibly, limitations. The field of human factors and ergonomics helps designers deal with this need. Still, as the use of technologies is also influenced by human behavior, it will also be very helpful to design technology in the visceral, behavioral, and reflective levels of emotional design so that the developed technologies will not only be functional and usable, but acceptable and more preferable to its users, as well.

Chapter 3

Methodology and Design

The following sections describe the methods and tools of research and software design for use in the development of CASSY, the proposed task management and toolkit system for teachers and academic professionals.

Software Development Life Cycle (SDLC)

The Waterfall model will be used in the development of the proposed system. Teachers, by the nature of their work, cannot afford frequent disturbances during classes, lesson planning, and other tasks. Since the model inherently minimizes necessary contact with the target users better than other SDLC models do, the proponents have deemed it a better fit to the development endeavor. Aside from this, use of the model will allow the proponents to put more effort into planning the software design. Likewise, the amount of documentation that can be generated as guided by the Waterfall model will also be helpful in subsequent and related software development endeavors to further enhance and extend the functionality of the proposed system beyond its intended design.

The following subsections describe all the activities and specifics related to each phase of the software development life cycle according to the Waterfall model and the relative schedule allotted for each phase and sub phase (see Appendix A for a complete Gantt chart of the SDLC scheduling. In addition, Figure 3–1 summarizes the workflow of the entire software development endeavor. For a complete list of tools to be used for each phase, please refer to Table 3-1.

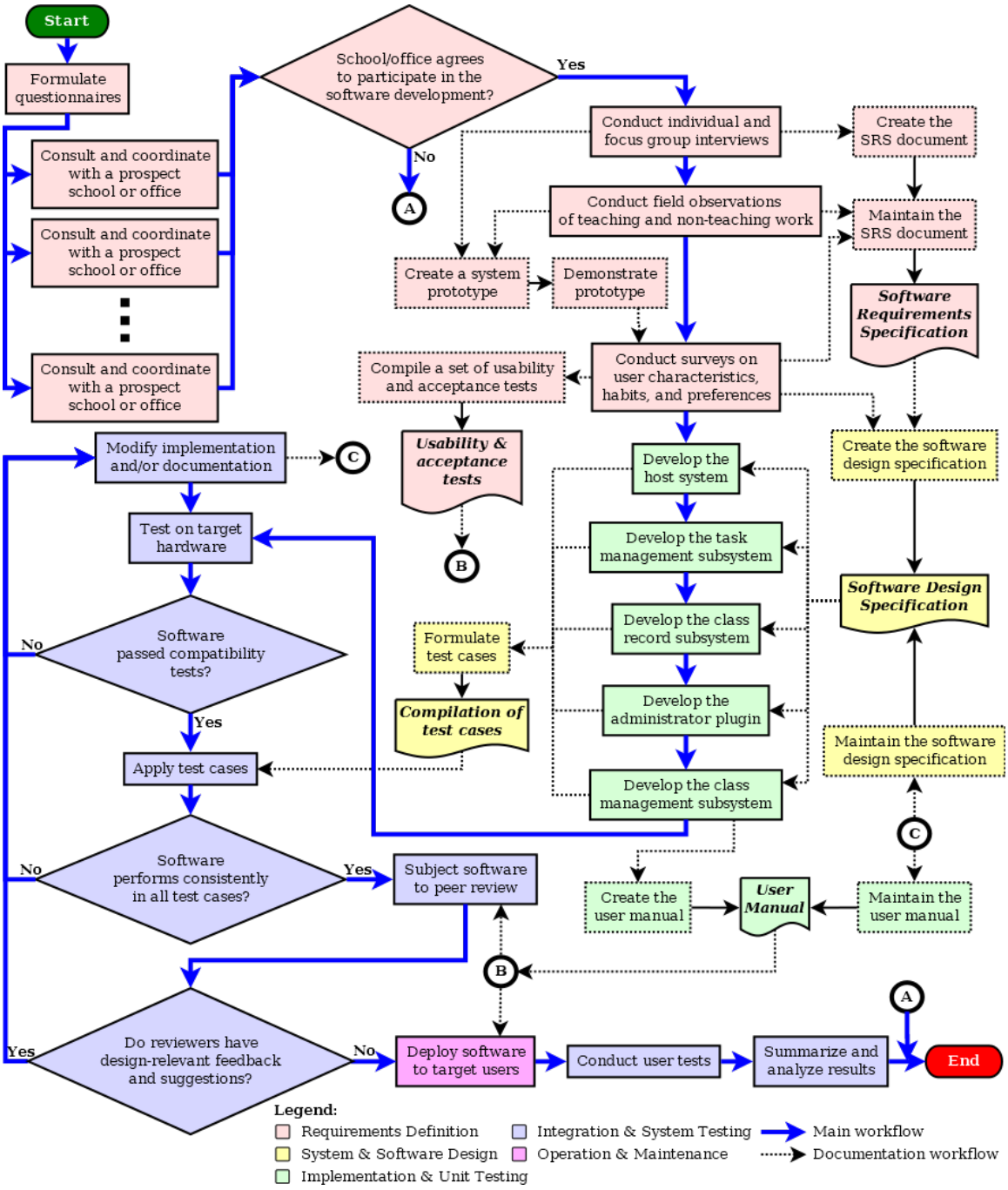


Figure 3–1 The Software Development Life Cycle Workflow

Table 3-1 Tools for Software Development

Tool			SDLC Phase				
Purpose	Type	Name	Requirements Definition	System & Software Design	Implementation & Unit Testing	Integration & System Testing	Operation & Evolution
Software Development & Testing	*IDE*	Embarcadero RAD Studio (C++ Builder)	✓		✓	✓	✓
	Version Control	GitHub	✓	✓	✓	✓	✓
	Development Platform(s)	Lenovo G410/20237 CPU: Intel® Core™ i3-4000M CPU @ 2.40GHz OS: Windows 10 Home SL (64-bit) GPU: Intel® HD Graphics 4600 Total RAM: 8.0 GB			✓	✓	
	Testing Devices	Windows-based Devices (variable specification)			✓	✓	✓
		Android OS-based Devices (variable specification)			✓	✓	✓
Documentation & Management	*Task Scheduler*	SDLC Chart and Calendar	✓	✓	✓	✓	✓
	Workflow	SDLC Flowchart	✓	✓	✓	✓	✓
	Documents	Software Requirements Specification		✓	✓	✓	
		Software Design Specification			✓	✓	
		Compilation of Test Cases				✓	
		User Manual				✓	
Research & Data-Gathering	*Questionnaire*	Interview Questionnaire for Individual and Focus Group Interviews	✓				
	Surveys	Survey on User Characteristics, Habits, and Preferences	✓				
		Survey on Functionality, Usability, and Acceptance				✓	✓
	Forms	Field Observation Form	✓				
		Management and Support System Analysis Form	✓				
	Web Server	Online Bug Reporting Facility				✓	✓
General Purpose	*Flowcharting and Diagramming Software*	Dia	✓	✓			
	Word Processor	Microsoft Word	✓	✓	✓	✓	
	Spreadsheet Software	Microsoft Excel	✓	✓	✓	✓	
	Presentation Software	reveal.js and slides.com	✓				
	HTML WYSIWYG Editor	BlueGriffon			✓		
	Text Editors	Notepad++/Sublime Text	✓	✓	✓	✓	✓
		Atom/Visual Studio Code			✓		

Requirements Definition

In order to create a system that is tailor-fit to the target users' needs, it is imperative to first understand the users themselves. During this phase, the proponents shall attempt to

understand the user and system requirements by examining the general nature of the work of the target users, as well as their characteristics, habits, and preferences. Data regarding these requirements shall be gathered using specific tools and methods. These requirements shall then be compiled and summarized in a software requirements specifications (SRS) document.

Sources of Data

The primary sources of data for the software requirements shall be the "respondents", which includes teachers and office personnel who volunteer from schools and offices that agree to participate in the study.

The secondary sources shall include documents that may define school and work policies and practices (e.g., memorandums, legislations, manuals, reports, etc.), documents or forms that may contain or can be used to gather work- or school-related data (e.g., lesson plans, class records, school forms, student lists, seat plans, worksheets, etc.), and information systems being used for work.

Tools and Instruments for Requirements Definition

To gather from the respondents the data needed to define the requirements properly, the proponents shall hold focus group and individual interviews, user surveys, and field observations. For these reasons, the following data gathering instruments shall be prepared and utilized:

1. Interview questionnaire – A questionnaire that will serve as a guide during the interviews for gathering valuable in-depth knowledge regarding the work and the work environment of the respondents.

2. Survey on user characteristics, habits, and preferences – A survey questionnaire for gathering user information that can influence software design.
3. Observation guide – An observation form that will guide the proponents in observing the respondents as they perform their actual work.
4. Survey on functionality, usability, and acceptance – A survey questionnaire for gathering user feedback.

The fourth item on the preceding list is included for gathering user feedback regarding functionality, usability, and acceptance after software deployment. Although its purpose is for system testing before and during deployment of the software, it is to be prepared as early as requirements definition and shall be modified accordingly during the course of the software development life cycle until its use during the system testing and operation phases. As for the results of surveys, these shall be treated and summarized according to mean scores.

Among the secondary sources, documents and forms used at work offer another qualitative perspective of the respondents' nature of work. Descriptive data regarding these sources will be valuable to the design phases. To make the documentary analyses more objective and organized, a document analysis guide shall be prepared to identify the following pieces of information, whenever applicable:

1. Document name
2. Document type
3. Purpose of the document
4. Content summary
5. Structure (for forms)

6. Kinds of information contained (for forms)
7. Manner of accomplishment and/or submission (for forms)
8. Data format
9. Points of interest

Information systems are information technology tools used in teachers' everyday work. As a guide, these shall also be analyzed by collecting the following pieces of information:

1. System name
2. System type
3. System purpose and functions
4. Kinds of information handled
5. User privileges/levels of access
6. Available interfaces

The focus of requirements definition is to understand target users' needs, as can be seen from the necessity for several data gathering tools. However, other tools such as an IDE and a presentation software are also needed to create prototypes and presentations that feature any proposed features. For a complete list of requirements definition tools, please refer to Table 3-1.

Requirements Definition Procedures

During this phase, requirements shall be gathered from the target users through interviews and surveys. Interviews will be conducted to understand the nature of work and

organizational environment and policies that the target users deal with every day. Surveys will be used to gather data regarding the habits and preferences of the target users. In order to gather respondents and participants in the surveys and interviews, schools and offices will first be consulted and the institutions who agree to participate in the study until the system is finished will be tapped as sources for the participants. Likewise, a prototype should also be developed to elicit requirements from the target users further.

Interviews shall be conducted individually or, more preferably, in focus groups, depending on which will be more applicable to the existing work settings. Candidates for individual interviews should be randomly selected from among the target users. Focus groups, on the other hand, will be more formalized and they shall consist of at least five (5) members, preferably the school head, the guidance counsellor, the ICT coordinator, a computer-proficient volunteer, and a non-computer proficient volunteer. The characteristics of the interviewees are thus defined in order to gain a broader perspective regarding teachers' work from varying points of view. Questionnaires will be designed to facilitate interviews. Interview topics will range from the daily tasks performed by teachers to the policies, practices, and issues in the education sector that affect the work of teachers in any way.

Alongside the interviews, field observations of the day-to-day activities of teachers and personnel in consenting schools and offices shall also be done. The activities to observe shall include but not be limited to actual classes, faculty meetings, and lesson planning. Observations shall be done either personally or indirectly via video recording, whichever is more likely to yield better observation results or more likely to reduce the Hawthorne

effect. However, considerable care shall be undertaken to avoid unnecessary infringement on the privacy of non-consenting parties.

After the interviews, a design prototype shall be prepared to show a preview of the proposed system. A non-plugin-based prototype may also be developed to demonstrate further the base functionality of task management. These prototypes will be shown later on in this phase to target users, especially to those previously interviewed, for comments, suggestions, and feedback.

Surveys shall also be held to further understand the target users, particularly their habits and preferences. Survey questionnaires shall be designed by taking into consideration the ergonomic principles of usability, activity-centered design, and emotional design. The respondents will be composed of volunteers. The volunteers for the surveys should also agree to participate in the final system-testing phases.

A software requirements specifications (SRS) document shall be concurrently created and maintained during the requirements definition phase. The SRS document shall be created and updated accordingly once data is made available. Once concluded, it shall be presented to stakeholders who wish to see it for review before it is finalized. The SRS document shall form a basis for the software design specifications of the next phase. It shall also be used to design tests for acceptance and usability, including test cases for validating functional system requirements, to be used in the system-testing phase. After finalization, the SRS document may only be modified to correct errors or to realign implementation and design with the requirements.

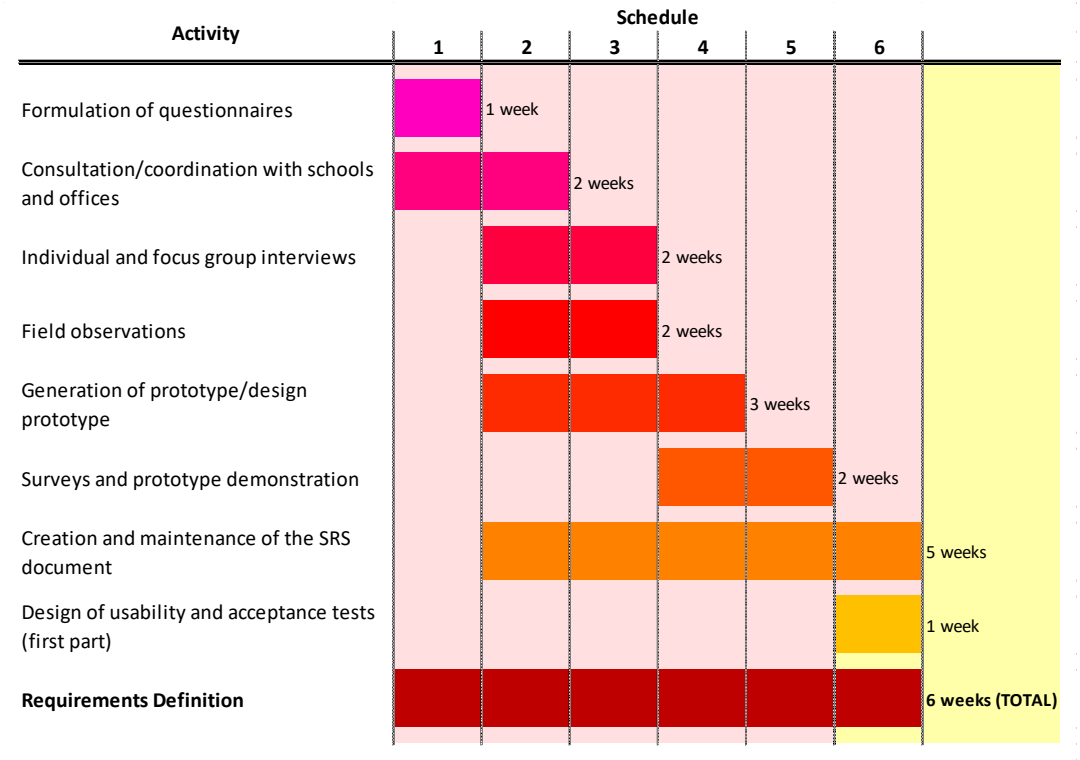


Figure 3–2 Time Allotment for Requirements Definition

System and Software Design

The creation of a software design specifications document shall commence once the SRS documentation is in its final stages. The software design specifications shall describe how the system shall be implemented in the subsequent phases. Models of the proposed system in different perspectives such as architectural and use case perspectives shall be made to guide or complement the design. As each functional design specification is stated, corresponding test cases shall also be formulated.

As this phase focuses on design and less on actual coding, the tools to be used are likewise geared for design. Please refer to Table 3-1 on page 49 for the complete list of tools, including those used for system and software design.

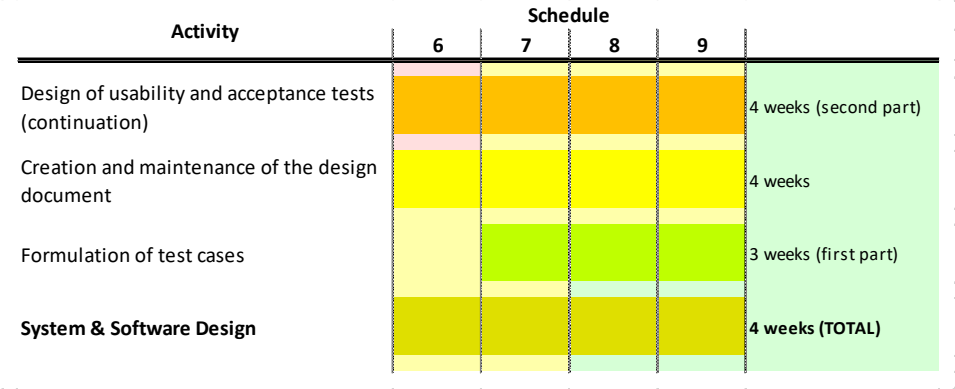


Figure 3–3 Time Allotment for System and Software Design

Implementation and Unit Testing

The implementation and development stage of any software development life cycle is usually the longest and, likewise, the most volatile stage, as it can be prone to change as software development advances. As such, this section will attempt to describe the schedules of the implementation and unit-testing phase in tentative terms. For instance, if particular subsystems change in relevance or previously unplanned subsystems are determined as necessary during the requirements definition phase, these subsystems may be added or removed from the development schedule or their priorities and scheduled durations may be modified to reflect the changes.

Some test cases become more evident once a system's implementation has begun. As such, the coding and actual development phase shall commence after the formulation of test cases has begun. Testing of each unit shall be done alongside the development of each.

Aside from the implementation of the software design, an online user manual shall be concurrently written. It shall be stored using the HTML format for maximum portability.

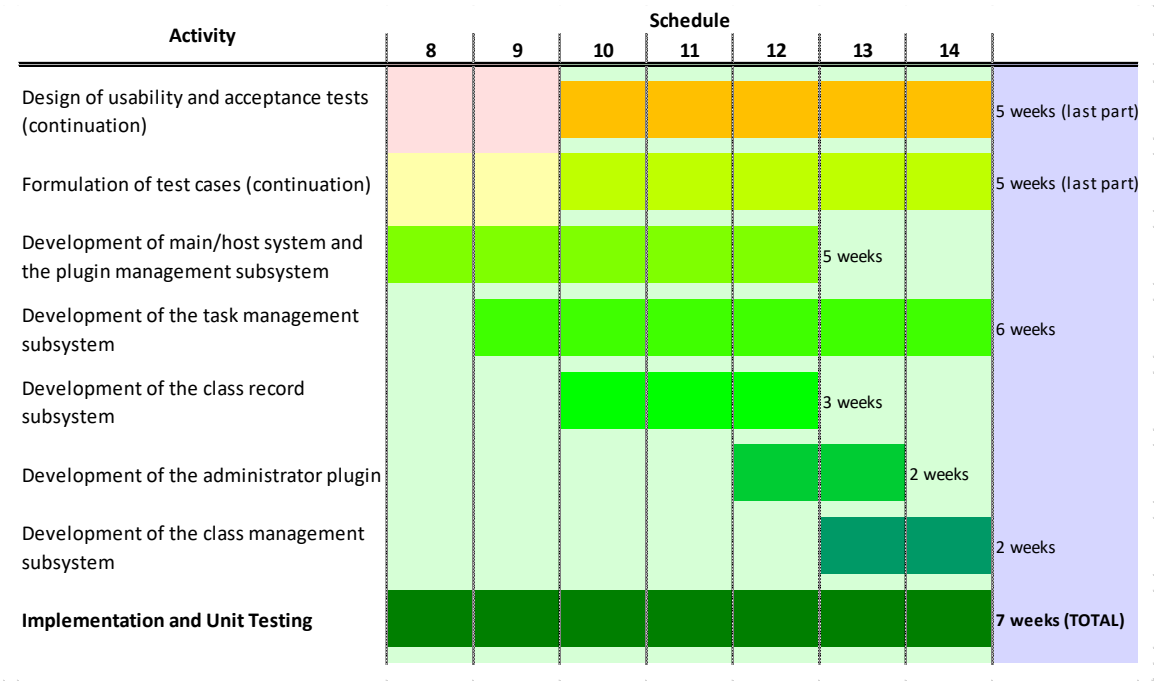


Figure 3–4 Time Allotment for Implementation and Unit Testing

Integration and System Testing

It is very important to first test the finished software product and validate whether it can fulfill its intended purpose. For the proposed system, the integration and system-testing phase shall begin with the installation of the proposed system on several target devices, including Android-based and Windows-based devices, to test for device and platform compatibility. Afterwards, test cases and other in-house tests will be used to verify the functionality of the proposed system. Once the proposed system has passed the in-house tests, it shall then be subjected to user tests coinciding with the system's operational deployment in order to validate the system's functionality, usability, and acceptability in the users' perspective. The results of each test will be summarized and analyzed in the next chapter.

Data-Gathering Tools and Sources of Data

During the system-testing phase, the data needed will be concerned with the respondents' perceptions on the functionality, usability, and acceptability of the software product. These data shall be gathered from the same respondents who have agreed to participate during the requirements definition phase. The survey for functionality, usability, and acceptance shall be used for this purpose.

As for the other tests in this phase, a checklist, which includes all the hardware used for testing, shall be used for hardware compatibility tests and peer reviews shall also use the survey for functionality, usability, and acceptance.

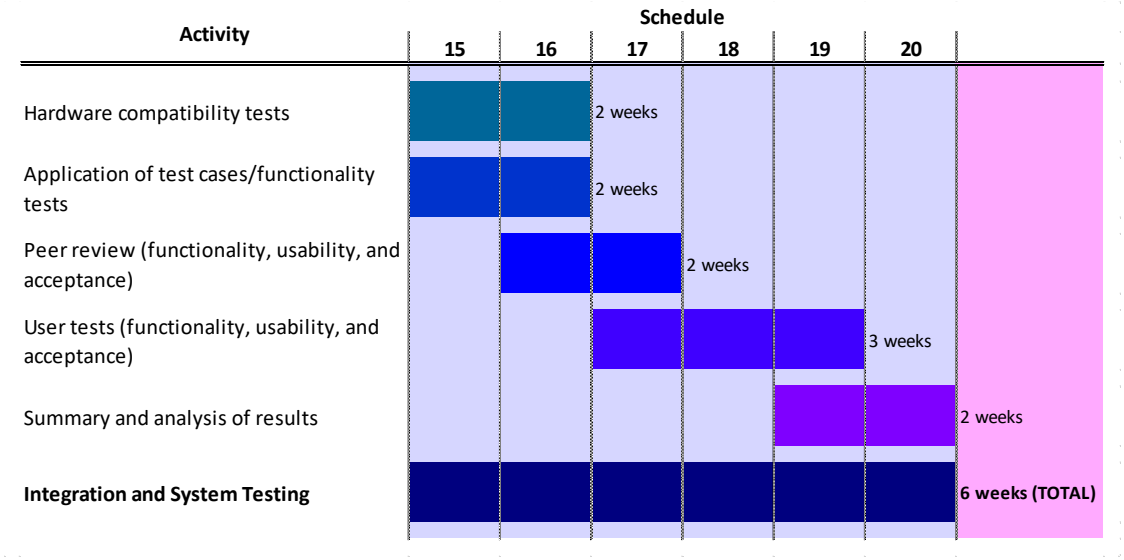


Figure 3–5 Time Allotment for Integration and System Testing

Operation and Maintenance

The operation and maintenance phase begins with the user tests. The results of the tests will not only conclude this study, but will also provide pertinent data for improving and evolving the proposed system in the future.

As part of the operation and maintenance phase, the proponents shall maintain a web server on the Internet that will serve both as a repository for the proposed system's installation packages and plugins and as an online error-reporting facility. Data received through the error-reporting facility will also aid in evolving and maintaining the proposed system.

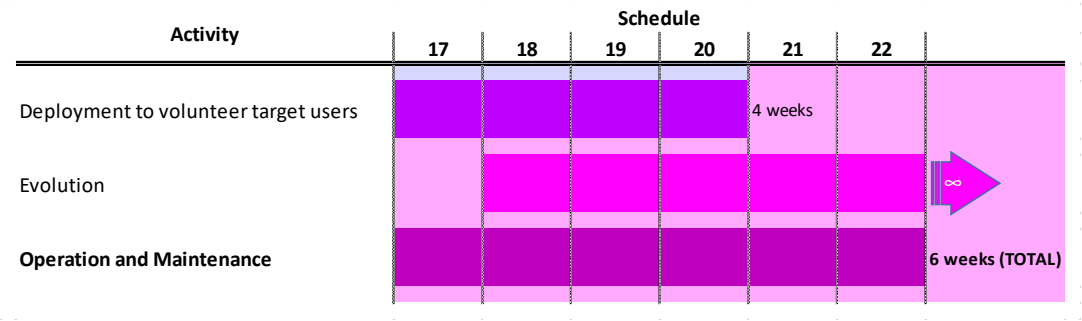
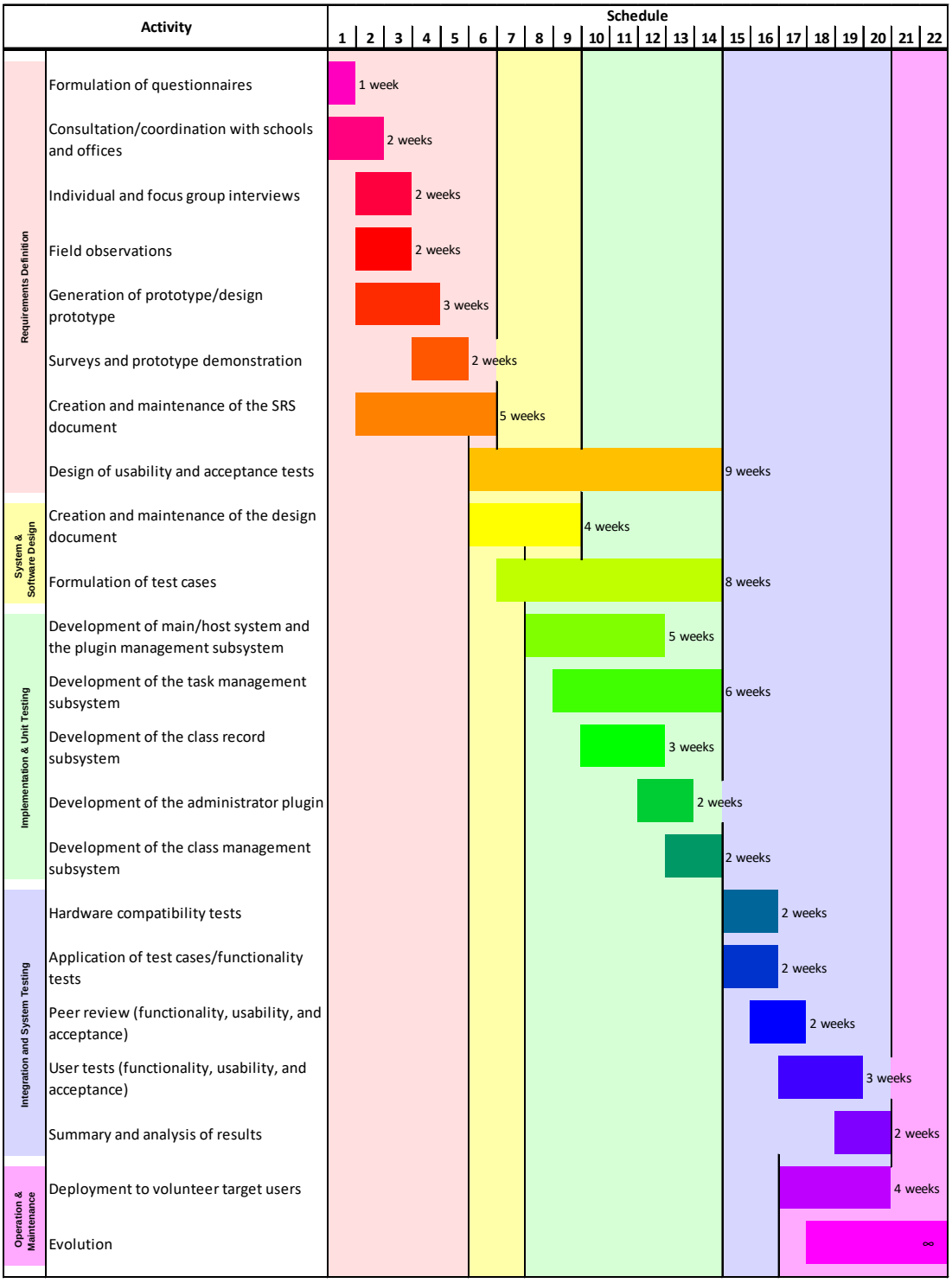


Figure 3–6 Time Allotment for Operation and Maintenance

Appendix A

Software Development Life Cycle for CASSY



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