BABES – BOLYAI UNIVERSITY CLUJ NAPOCA

FACULTY OF PSYCHOLOGY AND EDUCATIONAL SCIENCE

DOCTORAL SCHOOL

EDUCATION, REFLECTION, DEVELOPMENT

Integration of a Timed Browser in Teaching and Learning Programming Languages

Long Abstract

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CLUJ-NAPOCA
2015

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INTRODUCTION

Research aims and Focus

At present, traditional teaching faces challenges. Long-time instructors sometimes face difficulties abridging the technological gap, adopting pedagogical innovation (Papo, 2001; Reeves, 2003).

The importance of this research paper lies within understanding the essence of web pedagogy and the Internet integration process in academic courses instruction. In all researches conducted to data no unique software presenting contents by dates has been implemented. Yet at the context of integrating various software's and/or instructors/students' views of working with a certain software owned by the university have been conducted.

The researcher has worked as an instructor approximately seventeen years. Within my work, I have employed a wide variety of software. For more than a decade, the researcher has developed different models (software) of timed browsers, implementing them with hundreds of students through the years.

The researcher believes that this study may be a breakthrough, and first and foremost, it is a personal programming tool which the researcher constructed based upon his personal experience as an instructor and course coordinator. Secondly, the researcher believes that the timed browser may enhance learning motivation, through expanding self efficacy and, in fact, lead to improving academic achievements. The researcher's life-long dream is to construct a curriculum where the timed browser will fulfill a major role in computer science instruction.

Research Goals

Main Research Goal:

- To develop a model of a Timed Browser (TB - presenting academic content by date) to be integrated into Programming Languages Instruction in the Computer Sciences field.

Subsidiary Research Goals

1. To examine the effect of integrating TB in Programming Languages Instruction into the Computer Sciences field on learning motivation, self-efficacy, and academic achievements.

2. To examine the way in which TB integration is perceived by computer sciences students, in relation to their motivation to learn Programming Languages and their academic achievements.

Research Questions

1. What is the effect of integrating a Timed Browser (TB – presenting academic content by date) on the students' motivation to learn Programming Languages and self-efficacy?

2. What is the effect of integrating a Timed Browser (TB - presenting academic content by date) on the students' academic achievements while studying Programming Languages?

3. In what way do computer sciences student perceive the TB as a motivating factor in studying Programming Languages?

Gap in Knowledge

Most of the researches in teaching are not related to Computer Science. None of them relate to a certain necessity, behavior, or rationale.

Significance of Research

The aim of this research was to examine the way in which ICT (TB) improves learning processes. The research importance is that its results are likely to help teachers who can use ICT tools improve their teaching processes in schools, colleges and universities.

CHAPTER I: LITERATURE REVIEW

I.1 Literacy in the 21st Century

A new type of literacy is needed, to master technology that is relevant to today. The European Commission and several other countries have recently declared mastering ICT (information and communication technology) as one of the eight essential lifelong skills of the 21st century. This skill contributes much to those who master it as citizens, consumers and members of society (Aesaert et al, 2015).

I.3.1 Approaches to Integrating Computers into Teaching

From a historical perspective, integrating computers into education is not a particularly long process. Levien (1972) mentioned the integration of early computers, MARK1, in 1944 at Harvard University and ENIAC in 1946 at the University of Pennsylvania and describes them as the first swallows of computers in any educational system.

I.4 Theories Pertaining to Computer Science

Computer sciences occupies a growing place in our lives, and therefore, curriculum designers worldwide have agreed that basic knowledge and understanding of the technological aspect of computers and their uses are an integral part of the education that should be provided for students.

In addition and simultaneously, computer science developed from a scientific aspect, as the cornerstone for this development was laid even before the construction of the first computer and nowadays these two fields of development are intertwined and mutually accelerating.

Computer Science deals (mainly) with three types of theories:

A. Computational theories: looking for solutions to algorithmic problems, or alternatively proving that these problems cannot be proven. Analyzing the complexity of algorithmic problems and looking for the most effective solutions.
B. Systematic or theoretical complexity: analysis and design of large and complex software systems, which are typically simultaneous, distributed, and response-activated.

C. Cognitive theories: Planning "intelligent" systems, a combination of different areas in the study of human behavior and machine.

The purpose of Computer Science classes is to teach basic concepts of computer science and the principles of computer systems' structure. The curriculum emphasizes principles that have withstood the test of time, as opposed to technology-dependent concepts that would change quickly.

The purpose of the curriculum is not vocational training or teaching technological skills, such as learning a programming language to its fullest.

I.4.1 Theories on Teaching Computer Sciences

1. Deadlines

Software development is a complex process that is accompanied by many issues, such as failure to meet deadlines, delay in supply, changes in customer requirements, and lack of interpersonal communication (Brooks, 1987; Hamlet and Maybee, 2001; Tomayko and Hazzan, 2004). The system wishes to emphasize the transition from teaching to knowledge structuring (Table 2.I) by changing the power centers of the teacher/student, curricular activity and the role of technology (Derived from the management training presentation, education system's 21th century compatibility program, May 2012).

Table 1.I: from teaching to knowledge structuring

	Teaching (instruction)	**Structuring (construction)**
Activity in the class	Teacher is the center Didactic teaching	Student is the center Interactive learning
Position and role of the teacher	Passes information Always serves as the expert.	Collaborator Sometimes serves as an expert.
Role of the student	Passive listeners Always on the learner side.	Collaborator Sometimes serves as an expert.
Emphasis in teaching process	Facts, memorization	Relationship and connections, investigation and invention
The knowledge concept	Facts Accumulation	Facts transformation
Success expression	The quantity of knowledge	The quality of comprehension
Evaluation	By fixed standards	By criteria determined occasionally by the student.

2. There is No Uniform Standard for Software Development Process

Despite the accumulated experience in the field and despite the experience of teachers (Seungyeon and Kakali, 2007), there is virtually no agreement on one methodology that is suitable for all software projects. There are teachers who believe in teamwork so that the structuring of the educational material is done in a group setting – despite it being a Sisyphean sort of work, but "everyone learns from everyone".

I.4.2 Computer Sciences Programming Languages - Possible Difficulties

Experience shows that beginner students have difficulty understanding the basic concepts and principles related to programming, where they must simultaneously deal with knowledge of the programming language and the environment in which they apply the principles that they learned by writing and running computer programs. At times, it is also difficult for them to distinguish between principles that are independent from a single programming language and other technical aspects relating to the work environment.

Armoni and Gal-Ezer (2006) referred to the five difficulty levels of programming beginners:

1. **Orientation**: Beginner students have difficulty understanding what programming is, and 'What is it good for?" They find it difficult to control the different approaches to programming, and the various programming languages. In this situation, the distinction blurs between different levels of using ready-made software packages and programming;
2. **Understanding the notional machine**: Beginner students have difficulty understanding how a computer works, how to communicate with a computer, how to make it do what is intended, and so on;
3. **Understanding the meaning and syntax of a programming language** (notation): Beginner students have difficulty understanding the meaning of structures in language and using them correctly in writing the program;
4. **Specialization** (transition from novice to expert): Beginner students have difficulty making the transition to expert level, while acquiring tools and patterns for solving problems, which characterizes the experts;

5. **Performance in the workplace** (pragmatics): Dealing with technical aspects of the work environment, such as an operating system, editing files, compiling, monitoring a program's runtime, adds yet another level of difficulties.

I.5.1 Adapting the Education System for the 21st Century

Educational systems around the world make an effort to prepare their students for the 21st century, in particular in terms of incorporating technological tools and the Internet into teaching. To do so, several goals were defined:

1. Innovative pedagogy and providing 21st century skills.
2. Bridging the digital and educational gap.
3. Empowering teachers.
4. Strengthening ties between schools and their communities.

Christensen (2013) supports the transition from education based on curriculum to student-centered learning. From teachers' perspectives, there is less dependency on direction from principals or the Ministry of Education, and more examination and search for ideas and inspiration from other schools and from other countries. Figure 3.I presents elements of the perception of teachers' role.

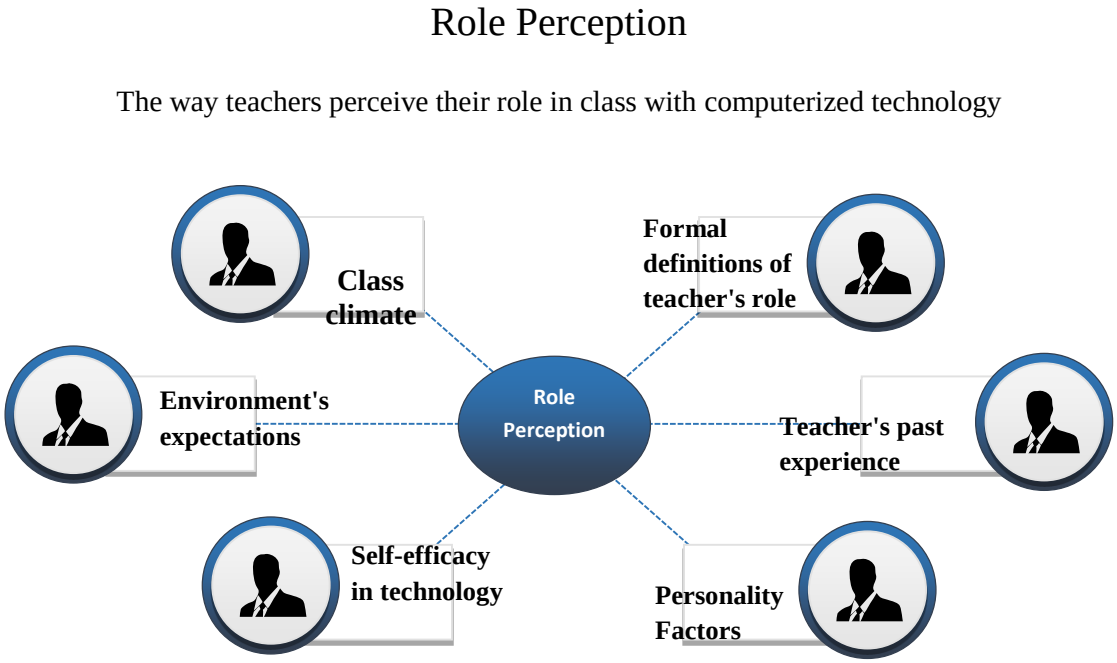


Figure 1.I: Elements of the teacher's role Perception

I.5.3 The Role of Teachers in the Integration of ICT Systems into Computer Language Teaching

According to Gilad and Malat (2004), "traditional" teachers must develop lateral thinking as opposed to deeply engrained thinking, such as is found in universities (for example highly specific studies that are perceived as good research) and this within a framework of an independent learning culture, both of teachers and students (Chis, 2011).

Gilad & Malat (2004) found that in the framework of virtual courses, a culture of independent learning developed among learners. They explained that learners were forced to deal with "technological alienation". That is to say that learners were not used to not having eye contact with teachers and other students. It is acknowledged that a large proportion of students even noted feelings of loneliness. It seems that "technological alienation" led to a revolution in thinking among students in that they learned to be "teachers" and even to think like that. In reality, it is possible to distinguish this in questions asked, knowledge understood, ideas, conceptions and self-production of information (Puzziferro & Shelton, 2014).

I.5.5 Contribution of E-Learning to Learning

a range of different examples of methods based on believing in students' performing with discipline, relating to the world as a changing environment, investigative actions and students' experiences, their activities and curiosity deriving from their inherent will to learn, and on more open dialog between students themselves as well as teachers and their students (Lantolf & Poehner, 2014).

As a result of the direct interaction between students and learned materials, information is processed and arranged by students themselves and as such is converted from information to knowledge (Conner, 2014).

Subsequently, studies have shown that there is a positive correlation between cooperative learning and students' improved self-image (Damini & Surian, 2014).

I.6. Motivation to Learn

The concept of motivation has been investigated many years, especially in the psychology, education, and sports disciplines. According to Assor (2005), motivation refers to "the desire to devote time and effort to a given activity, even when challenges, high costs, and lack of success are involved". Naturally, there are various theories and approaches to motivation, focusing upon different aspects of the phenomenon.

I.6.3 Self-Efficacy and Academic Self-Efficacy

Self-efficacy is one's judgment of his/her capabilities in organizing and executing a course of action required to attain a specific performance. (Schunk, 1991, p. 207). "Since Bandura's (1977) seminal article on self-efficacy, a broad scope of research has classified and extended the role of self-efficacy as a mechanism underlying behavioral change, maintenance, and generalization" (Schunk, 1991, p. 207).

According to the Self-efficacy Theory, the process of shaping and developing self-efficacy perception is based upon a set of previous experiences of success and failure, in association with academic tasks. Self-efficacy Theory emphasizes the social aspect of the learning process and motivation processes. Previous researches' results shed light on the affinities of students' sense of self-efficacy and past experience, feedback, encouragement, and support.

I.6.4 Teacher's Influence on Student's Motivation

Deci, Larand, et al. (1991) investigated teachers' styles, finding that certain teachers are oriented to supporting their students' autonomy, while others are oriented to controlling their students' behavior. The teacher's determination affects the class' general climate.

Ashton & Web (1986) maintain that self-efficacy and motivation may apply to teachers as well, not only to students. They referred teaching efficacy as one's own faith as for the ability to assist students' learning. Efficacy may affect teachers' actions, their efforts, and perseverance. Teachers with low self-efficacy may avoid planning activities which they feel are beyond their ability, as well as not to consistently support students who face difficulties, nor to search for creative solutions for crises.

I.6.6 Development of Curricula (Integrated Timed-Browser): Related Theories

Constructing a model for development and designing of a course integrating Internet into the instruction, it is necessary to again rely upon classical curricula development models. The dominant components in the curricula development process are very similar to the process of developing a web-based course.

I.6.7 Integrated Internet-Teaching Course Development Models

Web instruction design components include the teacher as a guide, and the student at the center, various material presentation methods, activities, problem solving, learner's personal progress pace, tests, feedback, easy navigation, help screens, and a consistent, clear structure (Janick & Liegle, 2001).

I.8 Mediated Learning

According to the theory of mediated learning, the cognitive structure of humans develops as a result of two distinct reciprocal activities between learners and their environment:

Mediated learning experiences take place when an adult (usually a parent or teacher) stands between stimuli whose origins are in the environment and learners, and mediates between a world of stimuli and learners. Mediators select the stimuli that they want to reach learners, put them in context, organize and regulate their appearance both in time and space.

The ability to learn is an extremely important feature for an education system, in that the amount of knowledge that can be instilled in students is determined primarily by their ability to absorb and digest this knowledge; but the ability to learn, change and adapt is important in many other areas.

I.9 Conceptual Framework

The research deals with the effect of integrating a Timed Browser on computer sciences students' learning. I used an Internet-based computerized system, of my own development, whose objective is to manage courses and lessons. The system allows a lecturer to administer a number of courses and lessons simultaneously, including presenting reports, opening and closing courses, including lessons.

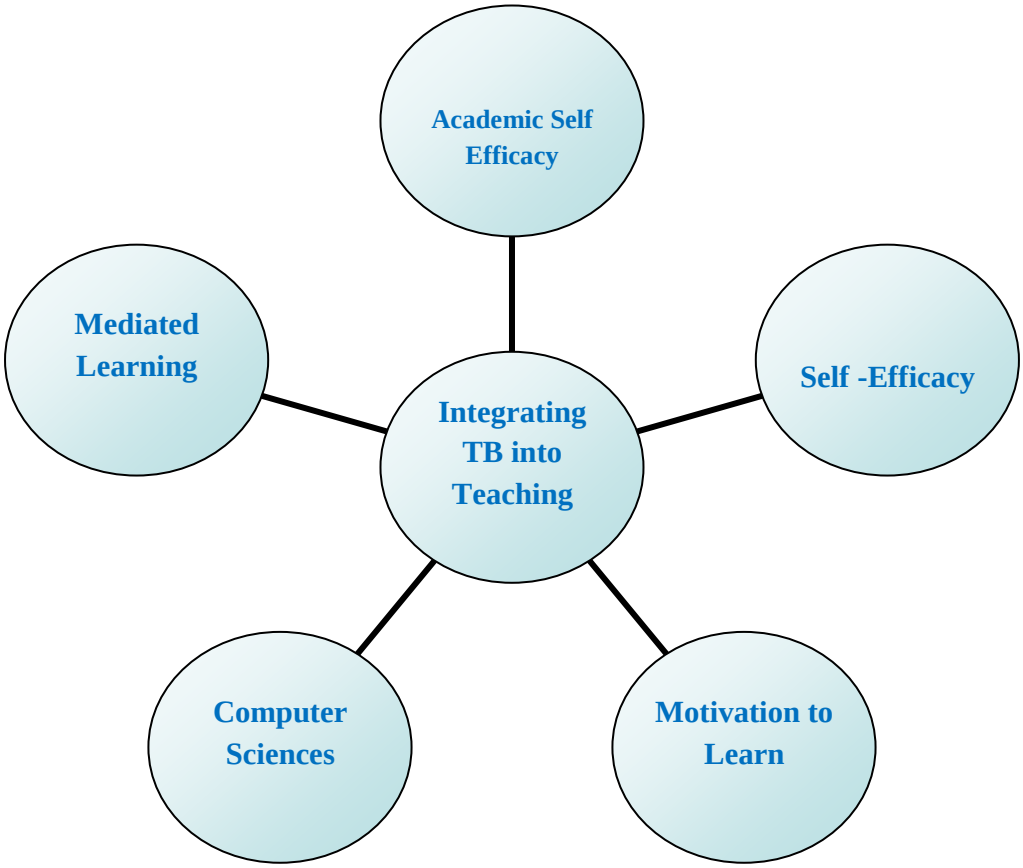


Figure 2.I: The Conceptual Framework

The term "Computer Science" is a component of this conceptual framework as it provides the academic context of research. In addition, self-efficacy and academic-self efficacy were examined, and hence chosen as components of this conceptual framework. According to Motivation to Learn theories, the higher one's self-efficacy, the higher one's motivation, and as motivation increases, so achievements rise.

Therefore, the conceptual framework includes the following concepts:

- ☒ Curriculum – relating to theories in the realm of education.
- ☒ Teacher/lecturer – the field of computer Science.
- ☒ Mediated Learning – a platform upon which the TB is based.
- ☒ Constructivist learning – explains how knowledge is acquired step by step, where each step in learning/practical experience enriches our repertoire. This concept also refers to learning from errors which is a significant part of Computer Science.

CHAPTER II: METHODOLOGY

The researcher has worked as an instructor approximately seventeen years. Within my work, I have employed a wide variety of software. For more than a decade, the researcher has developed different models (software) of timed browsers, implementing them with hundreds of students through the years.

II.1 Research Goals

Main Research Goal: To develop a model of a Timed Browser (TB - presenting academic content by date) to be integrated into Programming Languages Instruction in the Computer Sciences field.

Secondary Research Goals:

1. To examine the effect of integrating TB in Programming Languages Instruction into the Computer Sciences field on motivation to learn, self-efficacy, and academic achievements.

2. To examine the way in which TB integration is perceived by computer sciences students, in relation to their motivation to learn Programming Languages and their academic achievements.

II.1.1 Research Questions

1. What is the effect of integrating a Timed Browser (TB – presenting academic content by date) on the students' motivation to learn Programming Languages and self-efficacy?

2. What is the effect of integrating a Timed Browser (TB - presenting academic content by date) on the students' academic achievements while studying Programming Languages?

3. In what way do computer sciences student perceive the TB as a motivating factor in studying Programming Languages?

II.1.2 Research Hypotheses

1. Integrating TB within Programming Languages Instruction will enhance students' self-efficacy;

2. Integrating TB within Programming Languages Instruction will enhance motivation to learn Programming Languages

3. Integrating TB within Programming Languages Instruction will improve academic achievements

II.1.3 Research Variables

Dependent variable: effect of TB on: Motivation; self-efficacy (academic & applicable) and academic achievements

Independent variable: students' perceptions, integration of the TB, learning environment

II.3 Research Paradigm: Mixed-Methods Research

Recognizing that those interested in enhancing the quality of teaching are demanded a deep understanding of teaching and learning processes. This understanding may be attained by investigation and research (Livingston, McCall, & Morgado, 2009).

The primary goal of mixed methods research is triangulation, meaning cross-validation data for validation of findings and evidence of scientific meticulousness. Presentation of data collected through various methods strengthens their interpretation, and complements information (Alpert, 2010). For example, triangulation can be used by a combination of interviews and a quantitative survey, where one method supports and complements the other to strengthen the conclusions deriving from each (Rocco, Bliss, Gallagher & Pérez-Prado, 2003). Use of a combination of methods and triangulation neutralizes the disadvantages of each method separately.

Alpert (2010) describes two types of combination of methods: simultaneous order, according to which the research is pre-planned in such a way that would combine the two methods in each stage, from theoretical conceptualization through the design of methodology, data collection and analysis.

II.4 The Timed Browser Tool

In order to examine the research question on the effect of the integration of a Timed Browser, we used a web-based computerized system designed to manage courses and lessons. Below are the characteristics of the system. The system allows the lecturer to manage several courses and classes simultaneously, including viewing reports, opening and closing courses, and lessons. Lessons can be uploaded and ascribed to a number of courses at the same time.

Models and Databases

Courses

A course is defined as a collection of lessons and exams, and it is possible to open a certain course several times simultaneously without resetting previous courses.

Adding a Course

- **Name of the Course -** Name of the course that is opened.
- **Course Description -** a few words about the course.
- **Course Picture** – uploading an image sizes 600px over200px, which will be displayed as a background for the course description.
- **Lessons** – Assigning lessons to the course by choosing them from a list of checkboxes.
- **Exams** - Assigning exams to the course by choosing them from a list of checkboxes.

Editing a Course

- **Name of the Course -** Name of the course that is opened.
- **Course Description -** a few words about the course.
- **Course Picture** – uploading an image sizes 600px over200px, which will be displayed as a background for the course description (if no file is selected, the chosen file will not change).
- **Lessons** – Assigning lessons to the course by choosing them from a list of checkboxes.
- **Exams** - Assigning exams to the course by choosing them from a list of checkboxes.

Deleting a Course

- ☒ Deleting a course is done by clicking on the "Delete Course" button and approving the selection in the opened window.

Lessons

A lesson is characterized as a file that it given throughout a certain class in the course. A lesson can be associated with a number of courses at the same time, and it is possible to close one in the middle even if the class is over by indicating the page number where we stopped viewing the file, and clicking on 'Finish Lesson'.

Exams

Exams are characterized as a file that the lecturer gives to students in order for them to practice what has been learned ("lessons").

Users

- ☒ Users are individuals with permissions to view and manage the system. While creating a user it is possible to assign them with either administrative permissions ("lecturer") or viewing permissions ("student").

Adding a User

- ☒ **Student Name** - Name of the student to whom the user is assigned.
- ☒ **Username** – A username (in English only) that will be the logon name.
- ☒ **User Password** - A password (characters, numbers and English letters only), which will constitute the entry password for the system.
- ☒ **Permissions** - the permission level of the user, viewing or managing.

II.5. Research Design

Figure 1.II presents the stages of the research.

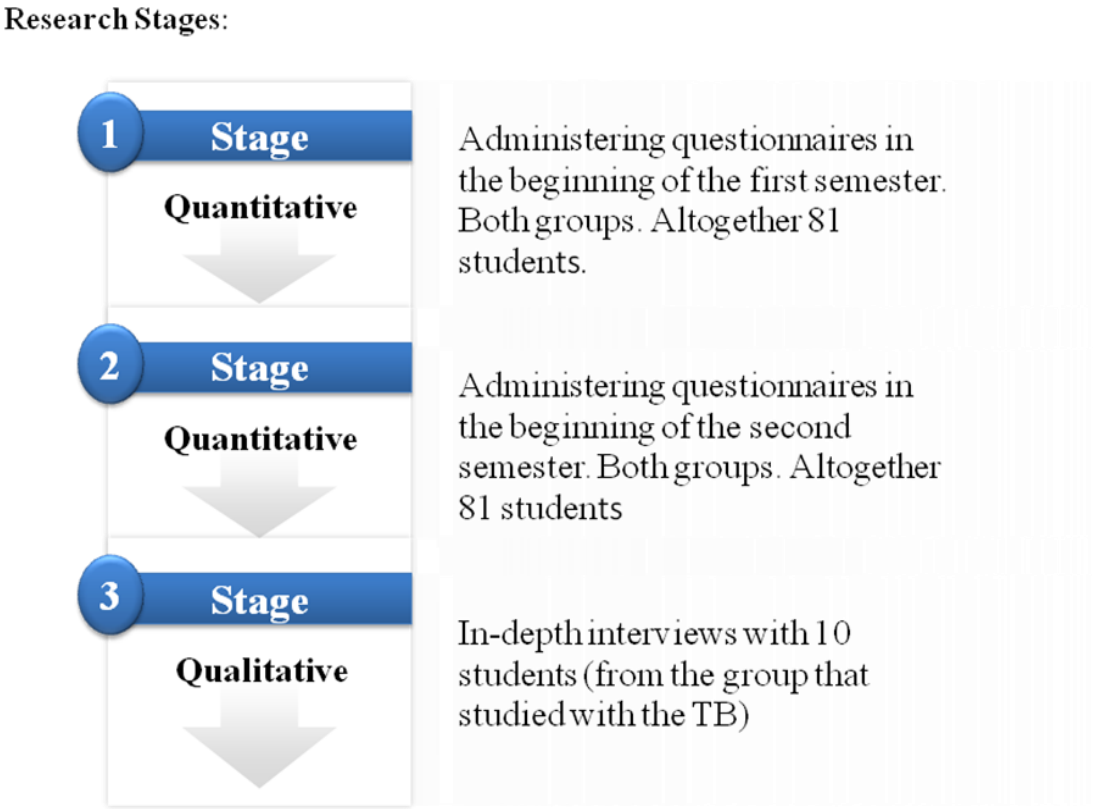


Figure 1.II: Research Stages

Table 3.II: Triangulation in this research

Type of Research tools	Research Tools	Population	Data Collection Stage
Quantitative	Closed ended questionnaires	81students: 40 in a class that used TB and 41 in a class without	Beginning and end of semester 2014 academic year
Qualitative	Semi-structured interviews	10 students who studied with the TB	End of semester, 2014

CHAPTER III: RESEARCH FINDINGS

III.1 Quantitative Demographic Findings

The following Tables present differences between the groups – demographic variables.

Table 1.III: Gender differences between groups

	Control without Browser	Research – with Browser	Total
Male	36	31	67
	87.8%	77.5%	82.7%
Female	5	8	13
	12.2%	20.0%	16.0%
Total	41	40	81
	100.0%	100.0%	100.0%

Table 1.III reveals no significant differences between the groups in the distribution of male participants (X^2=2.053, p=.358).

Table 2.III: differences between groups – high school majors

	Control without Browser	Research – with Browser	Total
Operating Systems	26	24	50
	63.4%	60.0%	61.7%
Graphic systems	2	0	2
	4.9%	0.0%	2.5%
Administrative Systems	13	16	29
	31.7%	40.0%	35.8%
Total	41	40	81
	100.0%	100.0%	100.0%

Table 2.III shows no significant differences between the groups with regard to the distribution of major subjects (X^2=2.378, p=.304)

III.2 Quantitative Findings

This chapter presents the research findings in three stages. First the differences between the groups in the first time point will be presented. In the second stage, differences will be presented for the second time point. The third stage presents differences between the groups while relating to the time that had passed between the two time points.

III.2.1 Differences between the Groups – Beginning of the Year

To examine the differences between the groups in the beginning of the year, T tests were conducted for two independent samples as depicted in the following table:

Table 4.III: Difference between the groups – the beginning of the year

	Without Browser (n=41)		**With Browser (n=40)**		
	Mean	**S.D.**	**Mean**	**S.D**	**t**
Motivation to learn	1.97	0.56	2.07	0.48	0.84
Learning confidence	2.23	0.56	2.44	0.47	1.82
Practical confidence	1.88	0.71	2.19	0.63	2.07*
Matriculation Grade	83.39	11.09	83.10	11.38	0.116

* $p < .05$. ** $p < .01$. *** $p < .001$

Table 4.III reveals that a significant difference between the groups was found only with regard to "practical confidence", where the students in the group with the browser had higher practical confidence than those in the group without a browser. In all other variables, motivation to learn, learning confidence and practical confidence, there were no significant differences between the groups. This leads to the conclusion that in general the groups resemble each other in the research variables.

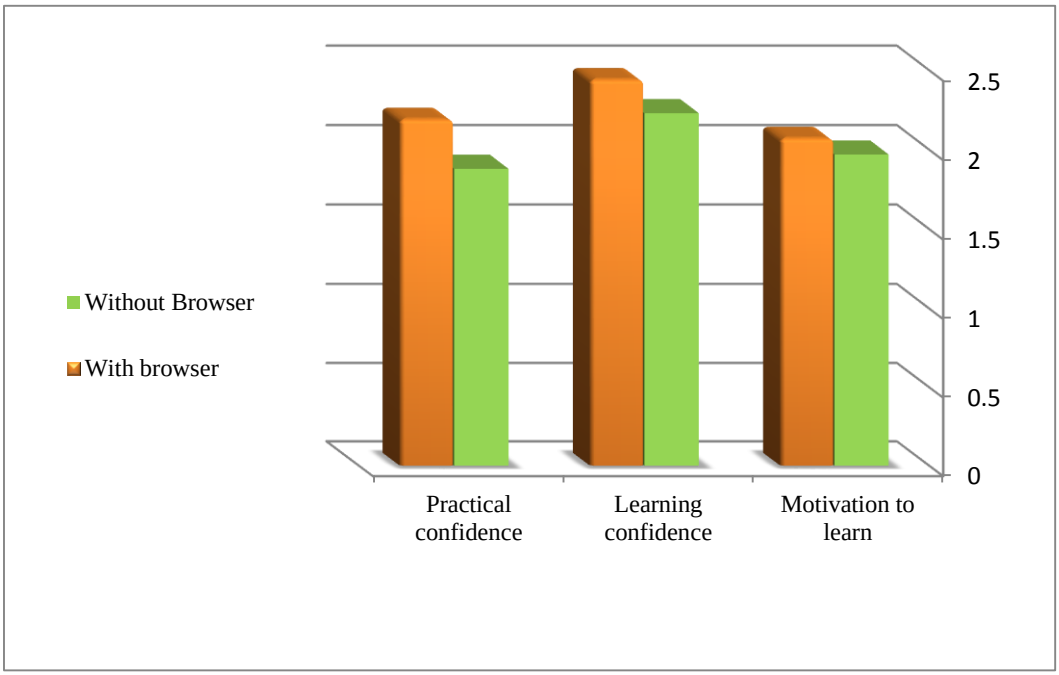


Figure 1.III: Differences between learning measures of students who studied with the Time Browser and those who studied without it at the beginning of the year

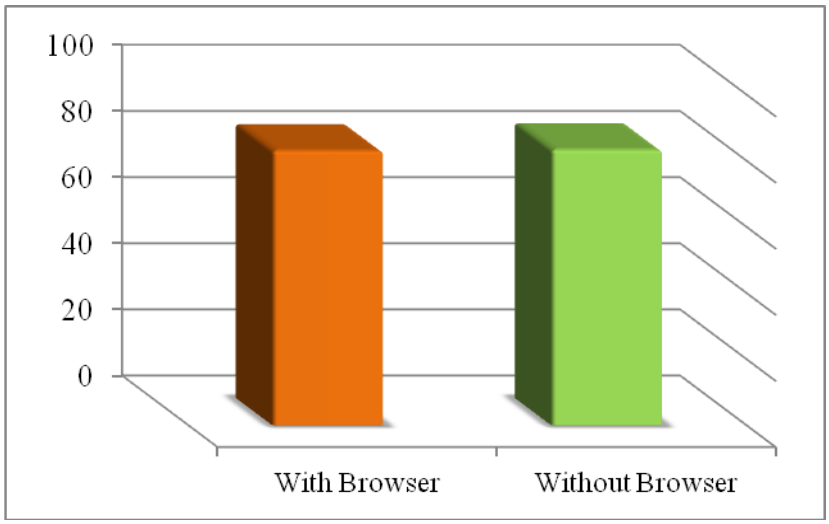


Figure 2.III: Differences between matriculation grades of students who studied with the Time Browser and those who studied without it at the beginning of the year

The following tables present the differences in research variables according to gender, specialty and type of language.

III.2.2 Differences between the Groups at the End of the Year

To examine the differences between the groups at the end of the year, T tests were conducted for two independent samples as depicted in the following table:

Table 8.III: Differences between the groups at the end of the year

	Without Browser (n=41)		With Browser (n=40)		
	Mean	**S.D.**	**Mean**	**S.D**	**t**
Motivation to learn	1.91	0.42	3.25	0.79	9.52**
Learning confidence	2.08	0.45	2.39	0.49	2.900**
Practical confidence	1.75	0.62	2.84	0.61	7.882**
External exam Grade	78.17	12.74	84.13	10.88	2.258*

* $p < .05$. ** $p < .01$. *** $p < .001$

Table 8.III reveals that students in the group with the browser had higher motivation to learn, learning confidence practical confidence and the grades on the external test than those in the group without a browser.

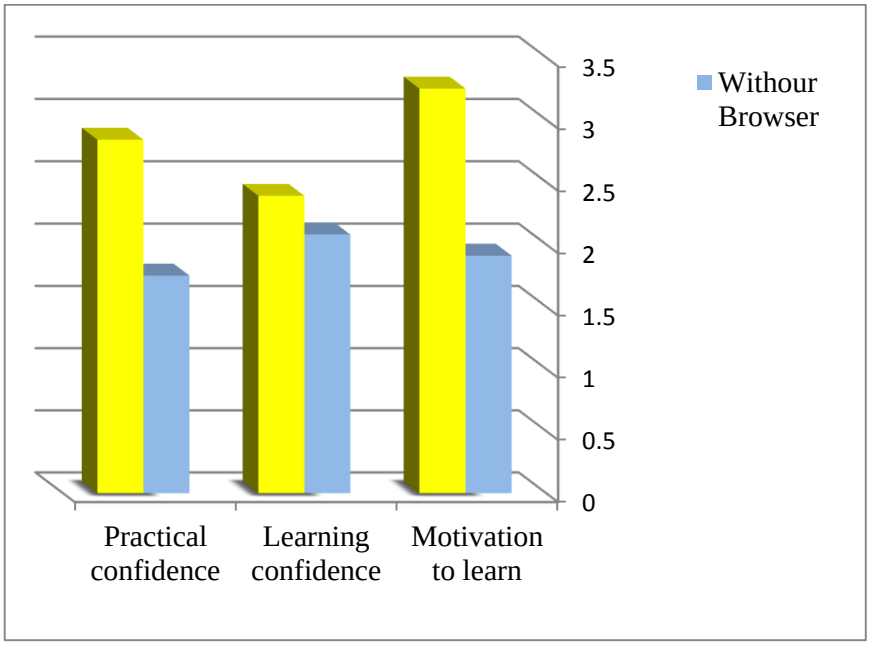


Figure 3.III: Differences between learning measures of students who studied with the Time Browser and those who studied without it at the end of the year

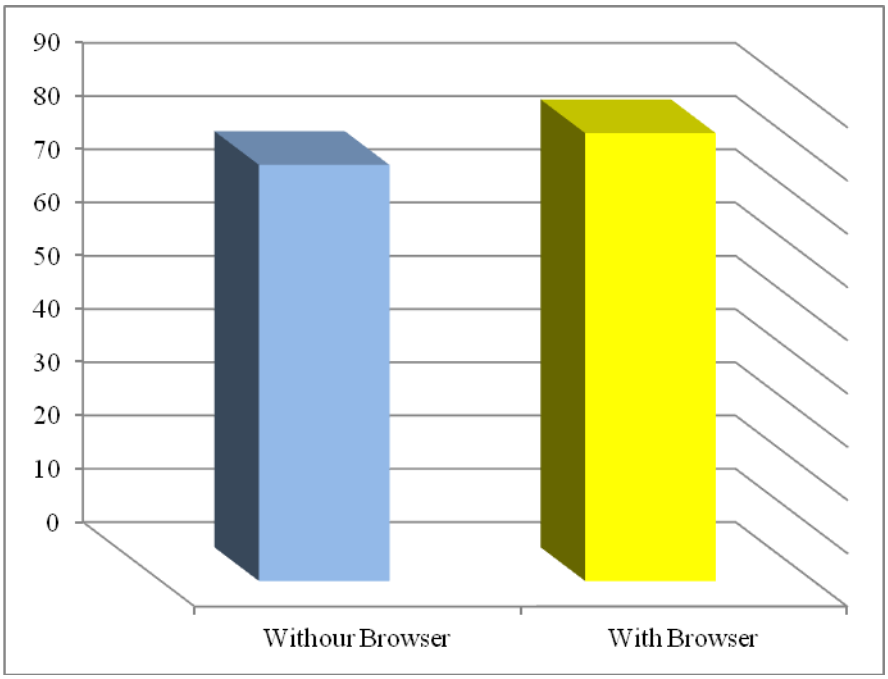


Figure 4.III: Differences between external exam grades of students who studied with the Time Browser and those who studied without it at the end of the year

The following tables present the differences in research variables according to gender, specialty and type of language.

III.3 Qualitative Findings

10 students from the class that studied with the Time Browser participated in the qualitative research.

Analysis of interviews conducted with students from the research group who studied with the Time Browser, yielded findings with regard to students' perceptions about the influence of the TB (Time Browser) on the study of programming language. Furthermore, the interview findings shed light on the motivation and interest in studying computer science.

Table 18.III: Themes emerging from the research

Theme / Category	Learning Perception of TB	Psychological perception of TB	Contribution of TB
1. Students' perceptions with regard to influence of TB on learning programming language	Positive-Medium	Positive-Medium	---
2. Contribution of TB to personal learning	Positive-High	Positive-High	Better connecting learning materials
3. Advantages of TB for learning	Positive-High	Positive-High	Maintaining learning continuum
4. Disadvantages of TB for learning	Negative-Low	Negative-Low	Harm to studies due to inaccessibility
5. Contribution of TB to increasing motivation to learn	Positive-Medium	Positive-Medium	Increasing wish to learn and imparting learning tools
6. Contribution of TB to increasing confidence in learning programming language	Positive-Medium	Positive-Medium	Increasing wish to learn programming language
7. Contribution of TB to collaborative learning	Positive-High	Positive-High	Improving students-teacher relationship
8. Effectiveness of learnt material for the students' future career	Positive-Medium	Positive-Medium	---
9. Significance of achievements in the course to the students	Positive-Medium	Positive-Medium	Students see connection between the system and achievements

II.3.1 Students' Perceptions of the Influence of TB on Studying Programming Languages

The perceptions of students studying computer programming on a practical engineer level with regard to the influence of the TB on programming studies are predominantly positive, when the students are assisted by a timed-browser in their studies.

III.4 Contribution of TB to Personal Learning

The students are largely assisted a lot by the course website, which includes support material, practice pages and presentations, files of different programs, and sample tests. By using the website the students can follow the learnt material and get up to date where necessary. The students reported about wide use of the website and have even defined the material on the website.

III.6 Summary of Qualitative Findings

1. The TB was **unanimously perceived to be promoting the learning of programming language**; this finding supports the findings emerging from the quantitative research.
2. **Students use the TB also outside the framework of studies in the college**;
3. The TB was found to promote face to face (F2F) pedagogy.
4. The TB was perceived as a tool that helps learning in the area of problem solving; for instance, reviewing and emphasizing materials studied in the previous lesson, sources of information, sharing information etc.
5. The TB was perceived as a tool that provides a convenient, available learning experience that is adjusted to cellular technology and allows for sharing information;
6. Unanimously – the TB's influence on learning programming language was found to be positive, mostly because of exposure to sources of information and materials, in a convenient user friendly and clear manner.
7. Difficulties were identified with regard to the TB software in the technological dimension, meaning the need to connect to the Internet, expiry of items, limitations on file size etc.
8. Increase use of the website of the course that integrates use of the TB was identified.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

V.1 Factual Conclusions

This research sought to find how the integration of a Timed Browser as a tool for managing teaching and learning in the field of computer science can increase students' motivation to learn, academic and technological self-efficacy.

The conclusion emerging from this research is that integrating the TB as a pedagogical internet based tool that enriches the learning activity, causes the students to experience various learning environments (some of which affiliated with educational institutions), which enrich learning via trial and error and solving various tests. All this activity as well as other activities contributes to learning, growth and an increase in use of the website of the course that integrates TB into teaching/learning.

V.2 Conceptual Conclusions

The research conclusions allow for presenting the Timed Browser as a major strategy in the management of teaching and learning in the area of computer science. Figure – depicts the model developed through this research:

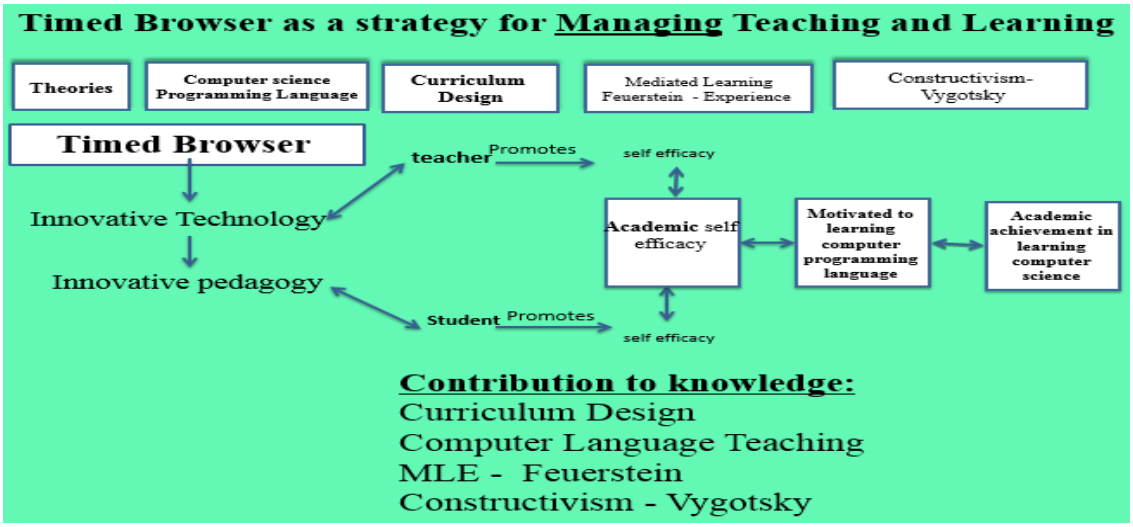


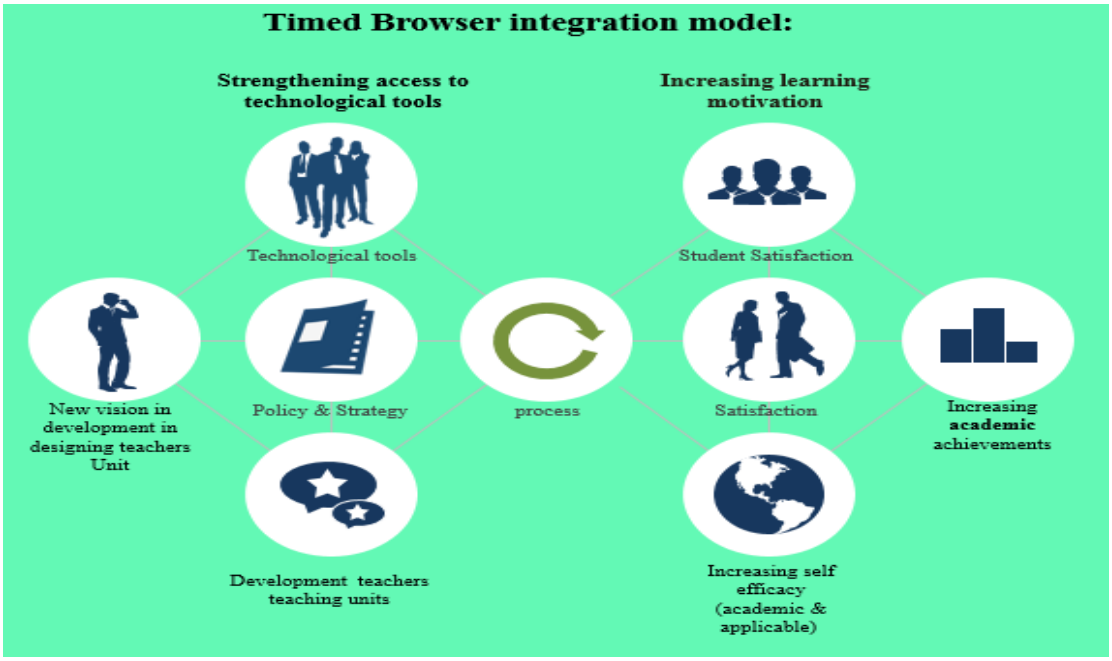
Figure 1.V.: TB as a Strategy for Managing Teaching and Learning in Computer Sciences

The model reflects the integration of TB as a strategy for managing teaching and learning in computer science. The model shows the TB as a technological tool

perceived as an innovative technology integrated into the teaching of computer science. This innovative technology manages teaching and learning and thus renders both processes highly effective. This effectiveness raises the level of students' academic self-efficacy, which in turn raises the level of motivation to learn thus teachers' technological self-efficacy, students' difficulties in adapting, and various school difficulties – all these may improve in time, although they require time. Furthermore, the influence goes two ways: the teacher's and students' technological self-efficacy is enhanced. The learner turns from a "static" or "passive" learner into a learner involved in the activity, summarizing contents, making comments and ultimately, at the end of the process, turns information into significant and meaningful knowledge. Furthermore, the cyclic nature of the model and mutual influences allow for a sequence of learning and narrowing gaps within the class.

V.3 Practical Implications

The research findings allow for presenting the integration of TB as a practical aspect of teaching and learning computer science.



The model shows that the realm of education is hungry for innovations and initiatives which ultimately enrich the world of contents.

The following recommendations are made here in order to guide computer science teachers as to how to integrate the TB into management of teaching and learning:

1. Establishing special professional development frameworks where teachers will receive explanations about the Timed Browser and its potential in managing teaching and learning;
2. The TB allows for sharing contents and tests among teachers from various educational institutions. In this way teachers engage in mutual fertilization, and enjoy access to each other's materials and cooperation with colleagues;
3. AS the TB constitutes an innovative pedagogy that might raise objections among teachers, strategies have to be employed to reduce resistance, and to provide teachers who are not essentially "technological" with tools to cope with it. Many teachers regard technology as an "enemy" rather than as a tool that can empower them and boost learning.

V.4 Research Limitations

1. The sample on which the research was based is rather small (81 students). This sample is not large enough to gain statistical strength to constitute a representative sample for the population of students who study computer science. Therefore, it is recommended that future studies reconstruct the design of this research while relying on a larger sample.
2. The current research design was that of quasi-experimental case study, where students were not assigned to their groups randomly. Such a design may compromise the internal validity of research, as it is possible that there had already been gaps between the groups. A preliminary examination conducted in the research ruled out this possibility, and showed that in general, students were quite alike in most dependent variables, and so validity was only minimally compromised.
3. The current research based its data collection only on the students' self-reports (except for their grades that came from an external source). No reference was made to the teachers' perspective. Future studies ought to examine further sources of information that may validate each other, and thus enhance triangulation.

V.4 Contribution to Knowledge

This research contribution lies first and foremost in its theoretical perspective, since the research examined the Timed Browser as a tool developed by the researcher, and since the research findings allowed for the development of a theoretical model of integrating TB in teaching computer science, the research closed a gap in knowledge in this area.

The research is original as it was based on a tool developed by the researcher, and hence the research is also innovative. The model developed from the research is based on existing theories of learning. In that, the research contributed to knowledge in the field of Constructivist Learning Theory (Vygotsky), Feuerstein's Mediated Learning Theory from the perspective of managing teaching and learning in the area of computer science (Ginat, 2001). Therefore, the main contribution of this research is in adding to theoretical knowledge from the point of view of teaching computer science.

V.5 Future Research

1. The research was conducted in a single college with a strictly technological orientation. It is recommended that the research be conducted in a number of colleges simultaneously and find if the results are still valid.
2. It is recommended that research of integrating the Timed Browser into teaching be conducted in another teaching/learning area from a variety of areas, and/or include other colleges or universities in the research.
3. It is recommended that comparative research be conducted between the integration of TB in hybrid teaching and integrating the TB in online teaching. The insights generated from such research may improve the integration of TB into teaching/learning.
4. It is possible to examine the perception of teachers working with tools for managing teaching and pedagogy that belong to a specific academic institution, versus tools developed by individuals regardless of their affiliation to a specific institution.

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Appendix 1: Research Participation Informed Consent Form

I _____ (Name and surname)

ID number _____

Address _____

I Hereby agree to fill in questionnaires in the framework of research in the field of Computer Science and Timed Browser, after I received explanations about the research and its goals.

The questionnaires are anonymous, and confidentiality is guaranteed regarding my personal information.

I am promised I will get answers to questions arising in the course of filling the questionnaire.

I hereby declare that I have freely and willingly agreed to participate and that I understand all that is written above.

_____ _____ _____

Participant's name Signature Date

I have received this consent form after having explained the research and its goals and made sure the participant understands my explanations.

Udi Lavi _____ _____

Researcher Signature Date

Appendix 2: Interview Questions

Motivation for and Interest in computer science studies

1. While studying Computer Sciences, do you prefer the material to be interesting/challenging for you to learn new things? Please specify:
2. Will you be able to deduce logical conclusions learned in one programming language to other programming languages, in terms of knowledge and skills you have acquired?
3. Do you think that misunderstanding the material is your responsibility or the instructor's?
4. Do you think the material you learn in the Computer Science studies is important and will be of assistance to you in the future?
5. Do you view achievements in Computer Sciences as important?
6. Do you feel confident of your ability to understand the challenging/abstract Computer Science material?
7. In what way do you prepare or assist yourself in the matter?
8. Does a challenging Computer Science material, discourage you or enhances your motivation?
9. Does part of your desire to succeed in Computer Science stem to show your skills to your close family and environment?
10. What, if at all, do you view your success in Computer Science as important?

Appendix 3: Questionnaire

Dear Student!

This research is part of a doctoral study which examines students' perceptions and behaviors.

This questionnaire will be given at two time-points, thus you are required to indicate the last four digits of your mobile phone, for follow-up purposes.

Let it be emphasized that your responses remain completely anonymous, and will serve for research and learning purposes only.

The questionnaire is written in masculine for but equally addresses both genders.

We thank you for your cooperation,

The Research Team.

Part One: Motivation and Learning

The following are statements describing feelings students experience in relation to their schooling. Kindly indicate to what extent each of the following feelings best refer your frequent experience at the current point in time of your academics.

Circle the most relevant digit

Regarding Programming Studies	Agree/Disagree				
	Strongly Agree	Agree	Partially Agree and Partially Disagree	Disagree	Strongly Disagree
I prefer a challenging study material, which will enable me to learn new things	1	2	3	4	5
I find it important to review the courses' study material	1	2	3	4	5
I prefer to learn material stimulating my curiosity, even if I find it difficult	1	2	3	4	5
I make an effort to understand the contents as thoroughly and comprehensively as possible	1	2	3	4	5
I take great interest in the content areas learned	1	2	3	4	5
I perceive the learned material as a start-off point, attempting to develop my own ideas in relation to it	1	2	3	4	5
Whenever I have the opportunity, I select courses from which I may learn, even if they do not guarantee a good mark	1	2	3	4	5
I try to employ my own ideas in association with what I have learned	1	2	3	4	5
I find most of the topics learned at the courses attractive	1	2	3	4	5
I find it very important to understand the material learned in the courses	1	2	3	4	5

Part Two: Academic Confidence

The following are statements describing the degree of confidence you feel in relation to your academic success. Considering this coming academic year before indicating the extent to which you agree or disagree with each of the statements hereunder in relation to you and your academics

Circle the most relevant digit

Regarding The Upcoming Academic Year	Agree/Disagree				
	Strongly Agree	Agree	Partially Agree and Partially Disagree	Disagree	Strongly Disagree
I can do excellently with the academic task assigned to me.	1	2	3	4	5
I know I will be able to learn and understand the study material	1	2	3	4	5
I expect to do well academically	1	2	3	4	5
I think I will not receive good mark during this academic year	1	2	3	4	5
My learning skills are excellent relatively to others'	1	2	3	4	5
I think that relatively to other students, I will be one of the top students of my year	1	2	3	4	5
I am sure I can successfully perform the class assignments	1	2	3	4	5
I feel that relatively to other students, my learning aptitude is excellent	1	2	3	4	5
I feel that relatively to other students, I know quite a lot about the learning material	1	2	3	4	5
I am certain I will be able to successfully absorb the learning material	1	2	3	4	5

Part Three: Practical Confidence

The following statements refer to your degree of confidence as for your ability in implementing the learning material related to the career you are pursuing. Considering the academic material and the career you are pursuing, to what extent do you agree or disagree with each of the statements hereunder in relation to yourself and your academics

Circle the most relevant digit

Regarding The Career You are Pursuing	Agree/Disagree				
	Strongly Agree	Agree	Partially Agree and Partially Disagree	Disagree	Strongly Disagree
I believe I can do well in various positions related to the career I am pursuing	1	2	3	4	5
I am certain I can perform any task related to the career I am pursuing, even if it is complicated	1	2	3	4	5
I will successfully withstand the numerous challenges associated with the career I am pursuing	1	2	3	4	5
I am certain I can successfully perform most tasks I will be assigned in relation to the career I am pursuing	1	2	3	4	5
Relatively to others, I can perform well most tasks related to the career I am pursuing	1	2	3	4	5
I am self-confident when I perform new tasks related to the career I am pursuing	1	2	3	4	5
Even if the tasks related to the career I am pursuing are difficult, I can perform them quite well	1	2	3	4	5

Part Four: Personal Information

1. Gender: A. Male B. Female

2. What was your high school career specialization?

A. Administrative Systems

B. Operation Systems

C. Graphic Systems

3. What is the type of language upon which you relied while performing your final project in 12th grade?

A. Object-Oriented Programming (JAVA or C#)

B. Procedural Programming (such as C language)

The last four digits of your mobile phone number: ____ ____ ____ ____

Thank you very much for your time!