Ατομική Διπλωματική Εργασία

EDUCATIONAL INFORMATION VISUALIZATION FROM METACOGNITIVE PERSPECTIVE

Μαρία Κασινίδου

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΥΠΡΟΥ

ΤΜΗΜΑ ΠΛΗΡΟΦΟΡΙΚΗΣ

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Επιβλέπων Καθηγητής
Δρ. Γιώργος Σαμάρας

Η Ατομική Διπλωματική Εργασία υποβλήθηκε προς μερική εκπλήρωση των απαιτήσεων απόκτησης του πτυχίου Πληροφορικής του Τμήματος Πληροφορικής του Πανεπιστημίου Κύπρου

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Abstract

Nowadays, rapid changes in technology have significant influence in learners' educational life. Humans are visual creatures – half of our brain is dedicated to visual functions. Moreover, 65% of the population are visual learners. What's even more impressive is that as images are processed simultaneously, we process them 60,000 times faster than we process text. Due the above, we consider that using infographics in learning efficiency will increase. Additionally, teaching by infographics helps students to interpret visual knowledge and provide a broader and extensive body of learning and grasp in education.

Every student has his/her own method to study and learn. The processes involved when learners plan, monitor, evaluate and make changes to their own learning behaviors is metacognition. It is an increasingly useful mechanism to enhance student learning. Metacognition makes a unique contribution to learning over and above the influence of intellectual ability. Learners who use metacognitive strategies are likely to be able to achieve more.

In this Thesis, we want to investigate whether to present educational content and in particular the content of the course EPL342 using infographics, helps students understand better and faster. In addition, we want to investigate if metacognitive strategies and motivation affect the students while they are studying.

In this Thesis, we want to investigate whether to present educational content and in particular the content of the course EPL342 using infographics, helps students understand better and faster. In addition, we want to investigate if metacognitive strategies and motivation affect the students while they are studying. For investigate if there are any relation between how content is represented and metacognition or motivation we create a system where a learner can create a profile with demographic information, information about course EPL342. We use 2 questionnaires to measure learner's motivation and metacognition to complete the profile. A learner login to the system and study 2 chapter from the course EPL342 one is

represented using infographics and one using prof. Samara lecture. At the end of each chapter student answer a quiz about the material. During the experiment we capture student gaze using gazept eye-tracking.

Content

Chapter 1

Introduction

1.1 Definition of problem

Teaching and learning process is one of the most important educational processes. Due to the fact that it is a highly complicated process in terms of both nature and procedures, it is often observed that each student has a unique learning style that is formed by having a specific learning pattern used for gaining knowledge from the educational experiences presented to them.

There are many different types of students. There are aural learners who respond primarily to sound can be challenging for teachers who aren't teaching a lesson about music. There are logical Learners are the ones who are always making lists, getting organized, and trying to find the link between one piece of the puzzle and another. Also, there are visual learners who are able to absorb information that they read, and their minds are able to absorb sets of data laid out in the symbology of language alone.

Every student has his/her own strategy which use for each different situation. Metacognition is defined as knowledge about cognition or “knowing about knowing.” It refers to thinking that enables the understanding, analysis, and regulation of thought processes. Metacognition

enables students to be more active in their learning, i.e., to mobilize all of their resources in order to have successful learning experiences. In order to do this, they must know how they learn and be aware of the steps that are followed and the means that are used to acquire knowledge, solve problems, and perform tasks.

Due this, it is important to find a way in which the teacher can convey more information to each student more effectively. We want to find a way to represent the content of lesson EPL342 which will help student to understand more efficient. We also can see if the different types of metacognition and how motivated the students affect the score and the time they need to read the content in lectures and in infographic form.

1.2 Purpose

Studies have shown that 90% of the information transmitted to the mind is visual and that 40% of Internet users respond better to images than to texts. Because of that, we want to see if the representation of the content of the EP342 course in the form of infographics affects students' performance. Also, we consider if different type of metacognitive skills and motivation of user affect the time spent to read and if he/she understand the chapter using the score from the quiz.

Based on the problem mentioned above, we came up with an essential system, which will be profitable and very helpful. This system will create the user's profile, the profile includes some demographic characteristics of user, some information about databases like grade at the relevant course and how confident feel about databases. Furthermore, to complete the profile we measure how motivated student is and his type metacognition using two questionnaires. Then, to see if infographic is more useful than lecture we ask student to read a chapter represented with infographic and a chapter represented using lecture. During the learning process we ask student to answer some questions, so we can understand his/her metacognitive skills. Additionally, we ask user to define how motivated they feel reading the content. Finally, we ask participant to do a quiz for each chapter he/she read. Besides profile information, we store to the database the time user spends to read each chapter and the score

which achieve to each quiz. We use eye-tracking to capture the gaze and fixations of learner during the learning process for the 2 chapters.

The questions that arise are:

1. Different metacognitive processes affect the time learner needs to study a material?
2. Different methods using to represent the content affect the learner?
3. Motivation affect how student study?

1.3 Recapitulation

My thesis consists of chapters. The first chapter denotes the speculation that is plaguing education, how can use infographics to teach and how metacognition and motivation affect students. Further, it mentions the purpose of my Bachelor Thesis. The second chapter defines the fundamental concepts of the elaboration and the understanding of the project. The third chapter indicates the design of the system, how infographics and database created. Furthermore, explained the flow of information and the eye-tracking. The following chapter presents minutely the design of infoVisLearnign system, the tools and technologies we used. Moreover, it explains the contribution of database and some stored procedure we created. The fifth chapter explicates the method we follow and the data analysis. The final chapter focuses in the future work and the general conclusion.

Chapter 2

Theoretical Background

2.1 Motivation

It seems that motivation can be conceived in many ways; e.g. many researchers formulated motivation by different approximations. Motivations are referred as the force that pushes someone to participate and complete a task. Pintrich and Schunk [1] mention that "Motivation refers to what a person will attempt, yet ability is defined as what a person can do". We have intrinsic and extrinsic motivations. Intrinsic motivation refers to the behaviors led by a force which push you to engage in something that you like and makes you feel an inward satisfaction. Extrinsic motivation, on the other hand, refers to the behaviors led by a force which push you to engage to a task for win/avoid something.

2.1.1 Tools to measure Motivation

Students' motivation is difficult to recognize and classify. However, recognize the lack of motivation may be easier. For measure motivation to measure incentives, we have many tools at our disposal.

- Jennifer Archer (1994) [3] created an inventory to assess mastery goal, the concern to demonstrate ability to others, and the lack of academic goal in university students. This type of inventory does not tell the researcher how strongly the statement applied to a particular student.
- Miller, Greene, Montalvo, Ravindran, and Nichols (1996) [4] used an 83-item tool called "Attitude Toward Mathematics Survey". In this particular study, they used sub-scales that assessed, self-perceived ability, self-regulation and cognitive strategy, persistence, effort, and student goals. This inventory tested student attitudes toward mathematics and has not been evaluated and validated for assessing general motivation, so we cannot use it.
- Pintrich, R. R., & DeGroot, E. V. (1990) [5] created the Motivated Strategies for Learning Questionnaire (MSLQ) is an 81-item inventory that measures two different types of scales: motivation and learning. This tool compares motivational and learning factors within and outside of the inventory. However, to assess intrinsic and extrinsic motivation there are only four questions each.
- Vallerand (1992) [1] suggested the Academic Motivation Scale (AMS) consisted of five subscales assessing amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation.

2.1.2 Academic Motivation Scale

The Academic Motivation Scale (AMS) is a tool invented by Vallerand et al., 1992 [2]. And it is based on the Self-Determination Theory (SDF). SDF claim that everyone has the perception of being the source of his own behavior, namely supports every individual has psychological need for autonomy and that there are different types of academic motivation.

These types can place on a ranging from amotivation to extrinsic motivation to intrinsic motivation. AMS used to measure intrinsic, extrinsic and amotivation across many disciplines. AMS has been tested and verified in students at different schools and languages, so generally has been accepted as reliable test of motivation.

The AMS contains 28 items divided into 7 subscales. Three subscales designed to assess extrinsic motivation including External Regulation which assess if a student participate to a task to avoid negative feelings, Introjected Regulation which measures the experience of pressure and guilt and Identified Regulation, which assess the feeling of importance personal value after participation to a task. Three distinct, unordered subscales designed to assess intrinsic motivation as Motivation to Know which measure if student takes part in a task for the pleasure and satisfaction experienced while learning, Motivation to Accomplish things which assess if student participates an activity for the pleasure and satisfaction experienced from accomplishment or creation, and to Experience Stimulation which assess if student perform a task to feel stimulation. Finally, the Amotivation measure the experience of a lack of motivation they are neither intrinsically nor extrinsically motivated.

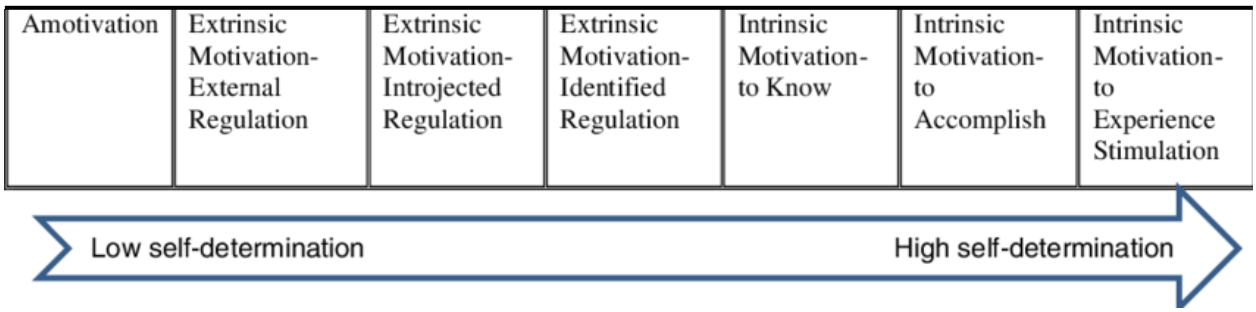

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Figure 1 - Academic motivation subscales

2.2 Metacognition

At a very early stage, Piaget (1950) was the first to refer to the concept of "knowing knowledge and thinking". However, according to Georghiades (2004) [8], the awareness of the person's knowledge had already been reported by Plato years ago. Aristotle also pointed out that the mind used a different force over and over to see and hear, and this discourages thinking about the existence of metacognition from very early. However, known as the first to use the concept of metacognition is Flavell at 1976 [6]. John Flavell, through his research, defining metacognition as follows: “metacognition refers to one’s knowledge concerning one’s own cognitive processes and products, or anything related to them”.

Flavell defined metacognition as information and cognition about the cognitive behavior and conceptualized it as the student’s information about his or her own cognition. Many other researchers after Flavell tried to define the concept metacognition. Brown (1978) [10] defined metacognition as learners’ awareness and organization of thinking processes that they use in planned learning and problem-solving situations. Wellman (1985) [9] defines metacognition as “thinking about thinking or a person’s cognition about cognition”. Ayersman (1995) [11], interpret metacognition as a result of one’s individual evaluation and observation of their cognitive behavior in a learning environment.

Metacognition is often considered to have two dimensions: metacognitive knowledge and metacognitive regulation. Metacognitive knowledge refers to what learners know about learning. This includes the learner’s knowledge of their own cognitive abilities, the learner’s knowledge of particular tasks the learner’s knowledge of different strategies that are available to them and when they are appropriate to the task. Metacognitive regulation refers to what learners do about learning. It describes how learners monitor and control their cognitive processes.

According Ahmet Oguz Akturk, Ismail Sahin (2011) [7] and Chmiliar (1997) [12] metacognition consists of 3 phases planning that appears pre-cognitive activities, monitoring

is observed during activities and, finally, the evaluation that appears after the activities. At planning phase individual considers knowledge about when, where and why different strategies should be used. At monitoring phase individual considers to the actual use of metacognitive strategies without instruction or prompts. In the end, at evaluation phase individual evaluates and changes strategy if needed.

©https://serc.carleton.edu/integrate/info_team_members/currdev/effective_materials/metacog.html

Figure 2 – Metacognition Phases

The tools used to measure metacognition vary, the most common is "Think Aloud Protocol" and systematic observations, that allow the researcher to determine individuals' "online" metacognitive ideas. Another fairly common tools which often used are questionnaires. The main disadvantage of questionnaires is that are based on an individual's own report and maybe not have been understood fully by all of the students. Finally, one more tool we can use are the interviews that can be used to get more information than the answers (maybe yes/no, or Likert Scale score) given by someone in a questionnaire. Using this method takes more time as required a mutual and interactive communication process based on asking and answering questions.

2.2.1 Metacognitive Awareness Inventory

Schraw and Dennison [13] developed Metacognitive Awareness Inventory (MAI) to assess metacognitive knowledge (Knowledge of cognition) and metacognitive regulation (Regulation of cognition). Knowledge of Cognition measured an awareness of one's strengths and weaknesses, knowledge about strategies and why and when to use those strategies. Regulation of cognition measured knowledge about planning, implementing, monitoring and evaluating strategy use.

The MAI consists of 52 questions divided into 2 subscales the knowledge about cognition and the regulation of cognition. There are 17 items assessing knowledge about cognition items; 8 items of declarative knowledge, 4 items of procedural knowledge, and 5 items of conditional knowledge. Furthermore, there are 35 items to assess regulation of cognition that consist of 7 items of planning, 10 items of information management strategies, 7 items of comprehension monitoring, 5 items of debugging strategies, and 6 items of evaluation. A participant has to respond to a Likert scale with number from 1(I never or almost never do this) to 5(I always or almost always do this).

Knowledge about Cognition refers to an awareness of one's strengths and weaknesses, knowledge about strategies and why and when to use those strategies. More specific, declarative knowledge assessing the knowledge of one's skills, the knowledge the learner needs before being able to process. Procedural knowledge measures the application of knowledge, how a learner implements learning procedures. Finally, conditional knowledge assesses the knowledge about when and why determines a specific procedure.

Regulation of Cognition refers to measured knowledge about planning, implementing, monitoring and evaluating strategy use. There are 5 subscales the planning which measures the goal setting and the allocation of resources prior to learning. The next subscale is the information management strategies which assesses skills and strategy sequences used to process information more efficiently. Comprehension monitoring assesses of one's learning or strategy use, also debugging strategies measures strategies to correct comprehension and

performance errors. Finally, is the evaluation which measures the analysis of performance and strategy effectiveness after a learning episode.

The score for each sub-scale is calculated by adding the scores on questions related to each of the factors. Higher scores correspond to greater metacognitive knowledge and greater metacognitive regulation. In addition to the knowledge of cognition score and the regulation of cognition score a MAI total score is derived by summing responses to all 52 questions.

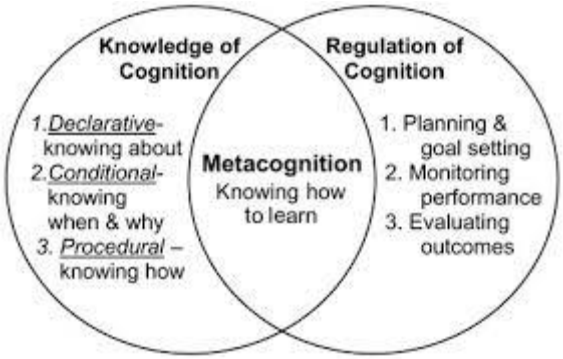

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Figure 3 – Metacognitive knowledge elements and regulation activities

2.3 Relationship between Motivation and Metacognition

According to research [14], [15], [16] have been done, there is a significant and positive correlation between metacognitive skills and motivation. Knowing the definition of Motivation and Metacognition we expected these two are interrelated. In both concepts, the feeling that one experiences is a key element. For example, when learners do their self-evaluation and feel proud of their achievements and be confident about their abilities they are more likely to be more motivated and attempt new and challenging tasks. Otherwise, if they feel ashamed and frustrated as they perform self-evaluations, they are more likely to be amotivated to attempt new tasks because they don't want to risk failure.

The connection is not only to the feelings learners experience, since metacognitive skills help students become more successful and as a result to feel more motivated. Low performance students often feel desperate by linking performance to previous failures. So, they feel they are not smart enough and lose interest, as a result they are less motivated. As students use metacognition to identify and find strategies to improve their areas of weakness, they can find hope and increase their motivation.

2.4 Information Visualization

As is customary to say, "one image is worth a thousand words". This is not at all accidental since, according to W. S. Cleveland [18], "The human brain is more capable of identifying and comprehending relationships and patterns if data is encoded into visual forms". Card, Mackinlay, and Schneiderman [19], defined infographics as "The use of computer-aided, interactive visual representations of knowledge to enhance knowledge".

Infographic or Information Visualization (InfoVis) is a new way of imaging the data. Schaiffe and Royers [17], defined visualization as "mechanisms by which people perceive, interpret, use and communicate visual information." Infographic is graphic visual representation of information, data intended to clarify and integrate difficult information quickly and clearly. They have other important qualities as well as providing more comprehensible and permanent information by visual transfer. Data visualizations and infographics that are well designed in terms of visuality, content and usefulness.

2.3.1 Types of Infographics

Use of writings, image, illustration, map and data visualization in infographics vary by content. In any case, infographics design is about storytelling. Infographics present viewers a story by visualizing intense, even complex information and processes on a certain subject in a manner to be easily understood and to create attention and curiosity. This visual story is

expected to create a change in the viewer. Some major types of infographics base on its usability are as follows:

• Statistical Based

This type of infographic includes diagrams, charts, graphs, tables, and lists. These forms show how a system works, lines of authorization of the company, shows sequential association. It can be made in interactive manner as well.

• TimeLine Based

Timeline show the sequence of events according to the time each event had happened. A timeline enables an audience to realize chronological relationships very quickly.

• Process Based

This type of infographic can be used to clarify in workspaces of factory or offices. It can make readers to understand about its practices in limited space.

• Location or Geography Based

With widely use of geographic information system (GIS), maps can also consider as the best way to show geography-based infographics.

• Informational

This type of infographic is the list-based. This type is composed mostly text and doesn't rely too much on graphs or other visual elements.

• Comparison

Making comparison between two products, ideas, thinks, etc. It can be used to visually contrast and compare seemingly opposing things.

• Hierarchical

Organizes information according to levels by importance or difficulty. The key of this type is to compare the different levels and show the relation between each of them.

2.3.2 Guideline to create an Infographic

The combination of visual storytelling with data presentation is the key driver behind the popularity of infographics and, in an age where data is everywhere, they have become genuinely indispensable. There is a basic guideline to follow to ensure the infographics that you create are both informative and beautiful.

1. Define the target audience

   The first step is to define the target audience, and this will set the tone of copy and the overall mood of visual theme.

2. Define the goal

   Break down the complex information and present it in an easy-way.

3. Find the right information

   Investigate and shift through data to find the right information.

4. Process the data

   Once you have the data you need to process them to achieve the goal.

5. Find the story in the data

   After the collection of data, you have to sorting, filtering and aggregating the information.

6. Create a wireframe

   This is the part where you start to translate the data int visual elements.

7. Design the infographic

   Bring the story to life. Choose colors, font combinations, right icons.

Chapter 3

Design of System

3.1 Flow of Information

Each user to log in to the system should initially create his / her profile. The user gives his or her personal information, name, surname, age and gender, as well as information about his or her knowledge of the database course. In order to complete his/her profile the user must answers 2 questionnaires the AMS which measures how motivated is user about why he/she goes to university, and then the MAI which measures the knowledge about cognition and the regulation for cognition. This information is stored in user's profile in the database.

When the user logs on to the system, he/her sees material related to relational algebra joins and normalization which were represented using 2 different methods. The first method is using course traditional slides and the second method is using more visual form of the lecture. He/she has to answer a related quiz to each chapter. In the database is stored the time user spent in the 2 chapters each other, as well as the answers and the score in the 2 quizzes. At the same time, using the eye-tracking we get metrics like fixation, duration of fixation while he/she tried to read lecture or infographics about the 2 chapters.

During the experiment, we use Think Aloud Protocol, so we asked the participants to answer aloud some questions before, during and after the end of the reading in each chapter to confirm the measurements we took for metacognition. In addition, we asked participants to indicate periodically how motivated they felt from a scale 1 to 7.

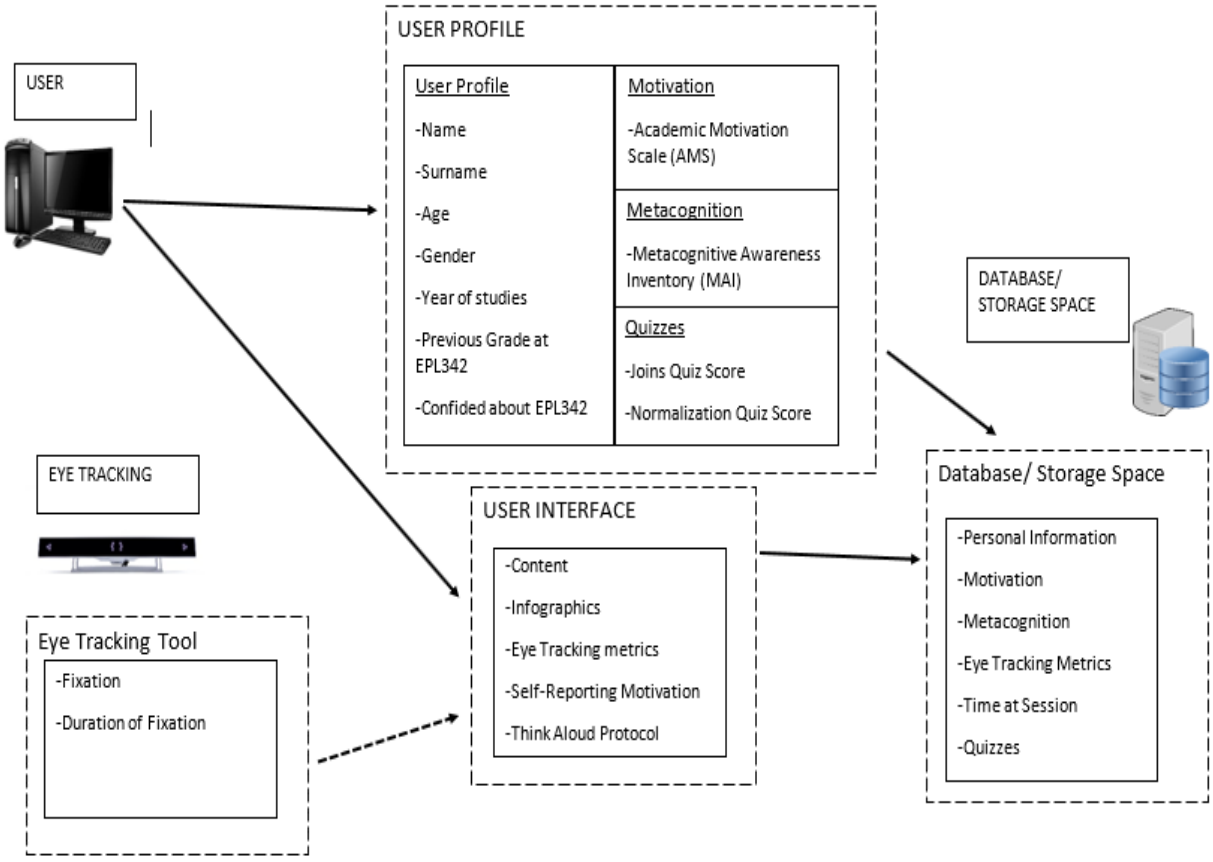


Figure 4 – Information Flow

3.2 Infographics

First of all, before infographics creation we had to determine the target audience. We decided that we targeted students who attended the database lesson. Then we studied the content of course and in cooperation with Mr. Samaras decided the chapters in which the students had the greatest difficulty to understand. We ended up with 2 chapters that we could convert to InfoVis, Joins at Relational Algebra and Normalization and so we studied these chapters more. Fully understanding the lectures, we had at our disposal we set the goal for each chapter. The goal for join was to understand the different types of join and the different from each other. The goal for normalization was to show the reduction of the anomalies in every normal form, as well as the characteristics of each normal form. To achieve our goal and having all the data we needed, we had to find a "story" with beginning, middle and end that could bring the reader the information to reach the goal we set.

3.2.1 Infographics about Relational Algebra Joins

Beginning: A join clause takes has as input one or more relations and as output a new relation.
Middle: There are 6 different type of joins.

- Θ-Join: combines 2 relations based on a condition.
- Natural Join: combines 2 relations based on an equality condition, remove duplicates.
- Semi-Join: combines 2 relations as a result a new relation with all the features that only belong to the first relationship and satisfy the situation.
- Anti-Join: combines 2 relations as a result a new relation with all attributes that belong only to the first relation and does not satisfy the condition.
- Left (Right) Outer Join: combines 2 relations as result a new relation with all the attributes belonging to the two relations and all the tuples of the left(right) relation, if a tuple of the right(left) relationship cannot be joined with a tuple then it gets the null value.

- Full Outer Join: combines 2 relations as result a new relation with all the attributes belonging to the two relations and all the tuples of the left and the right relations, if a tuple of the right or left relationship cannot merge with a tuple then it gets the null value.

End: How to use the different types of Joins.

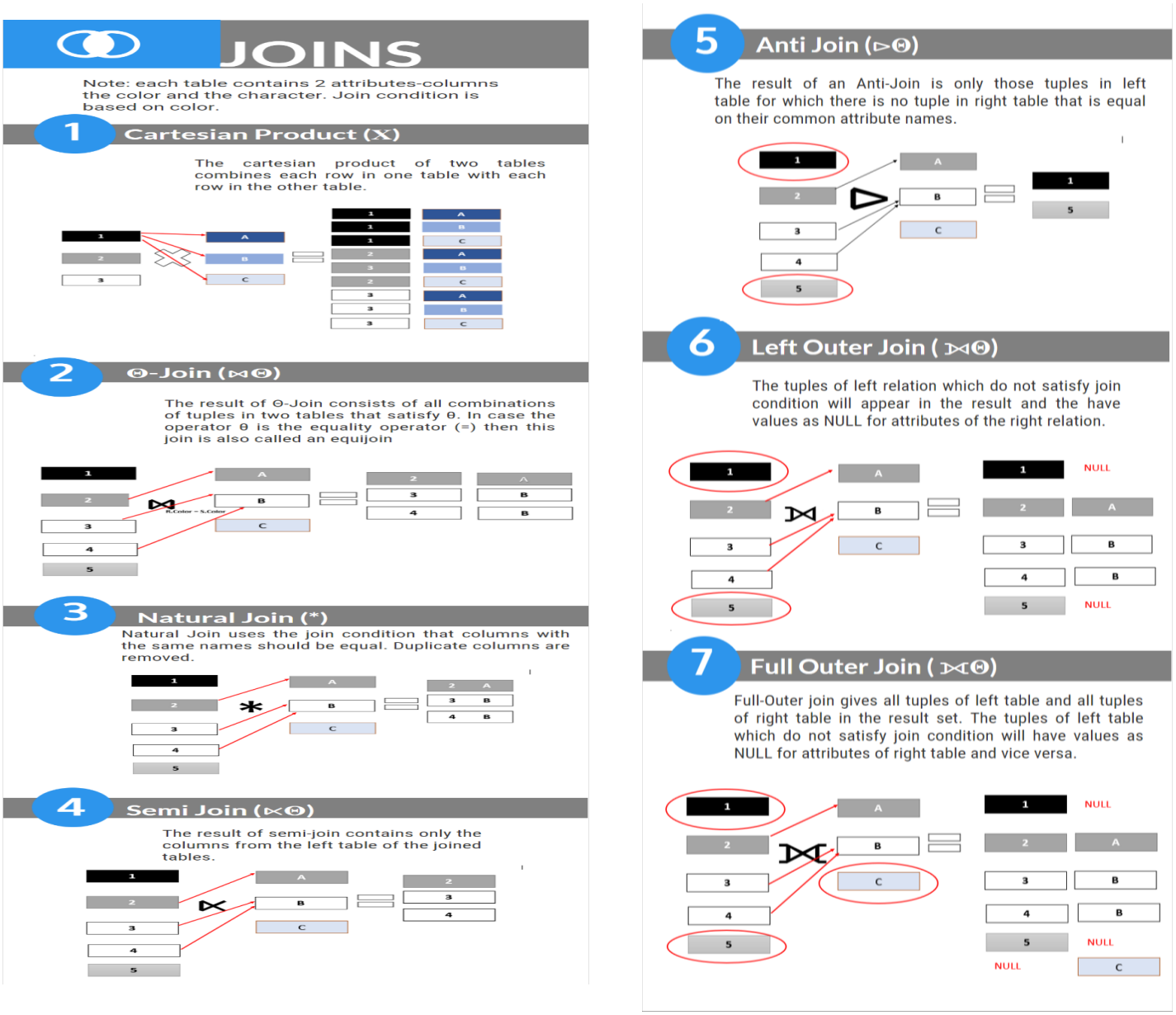


Image 1 – Join Infographic

3.2.2 Infographics about Normalization

Beginning: Normalization is a process of reorganizing a database according to a set of standard formats to reduce data redundancy and improve data integrity.

Middle: The 6 Normal Forms

1NF: only individual values for the attributes, not multivalues

2NF: Fully dependent attributes that are not keys to the key

3NF: attributes that are not keys are transitively dependent on the key

BCNF: a single candidate key

4NF: we do not have nontrivial multivalued dependencies.

5NF: we do not have nonloss projections in each view we have the key

End: In each normal form, the anomalies of the relationship are reduced.

After we decided what information we were going to present we had to decide how to visualize them to make them more understandable and distinctly.

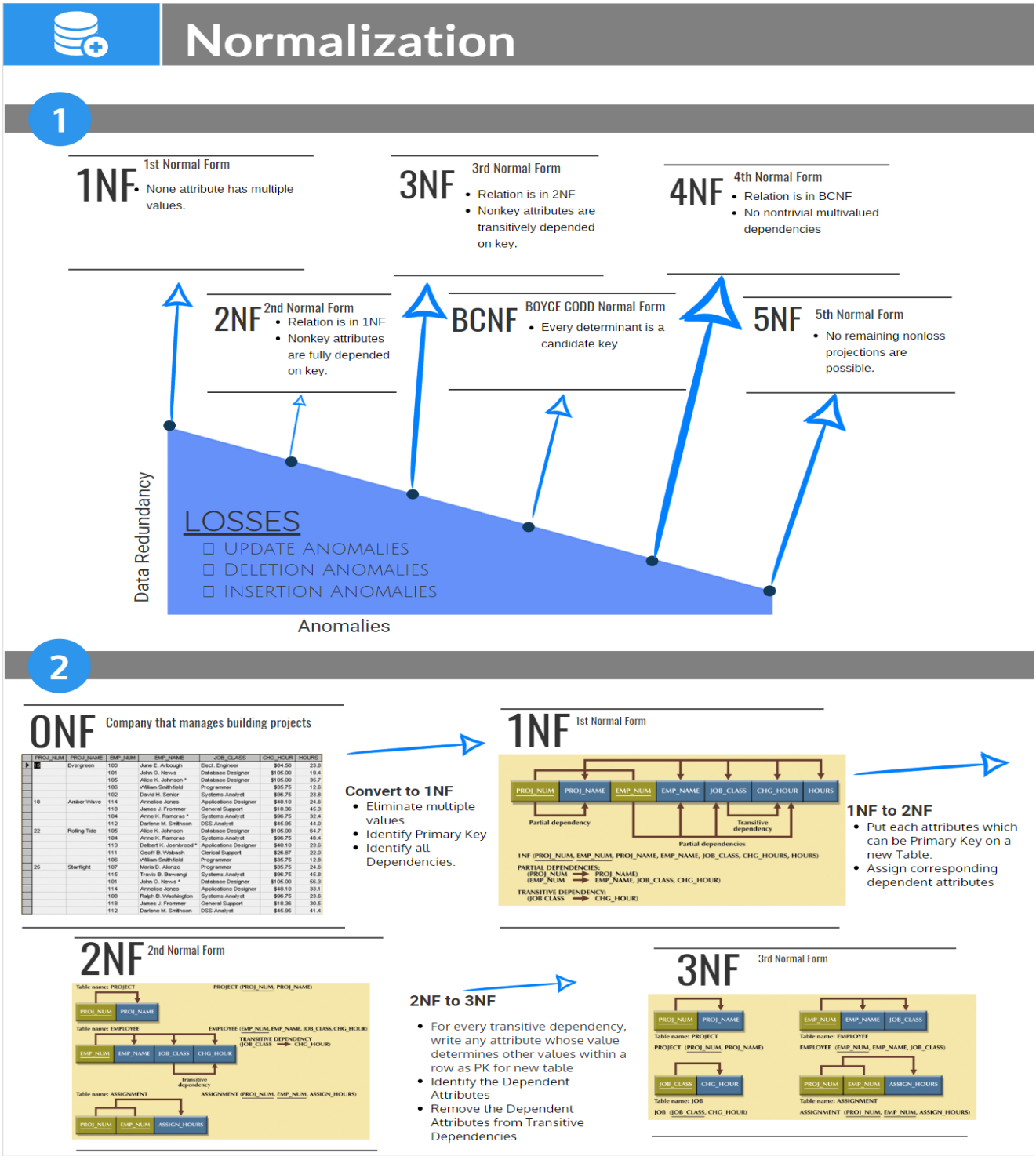


Image 2 – Normalization Infographic

3.3 Database

In the database there is USER relationship in which there are information about the user's profile, such as name, surname, username, password, gender, age, year of study. There is also information about the course of Databases as the degree at the lesson and how well the user knows the database. Furthermore, there are the motivation, the knowledge about cognition and the regulation for cognition as foreign keys from Motivation and Metacognition tables. There are also, the time user spends to the 2 different chapters. Finally, there is the type which is the way learner sees the material, if the type is '1' that means the learner saw the chapter of Joins presented with traditional slides and the chapter of Normalization presented with a more visual way and type '2' is the reverse.

In addition, there are Motivation and Metacognition tables where is stored the answer for the AMS and MAI questionnaires respectively. There are also stored the values for subscales of each questionnaire. Furthermore, there is Quiz table which include the answers given by the users to each question as well as the score scored at 2 quizzes. Finally, there is the Comments table where is stored for each participants the comments from Think Aloud Protocol both for Joins chapter and for Normalization. All tables use as primary key the username.

Below are the relationships in the database.

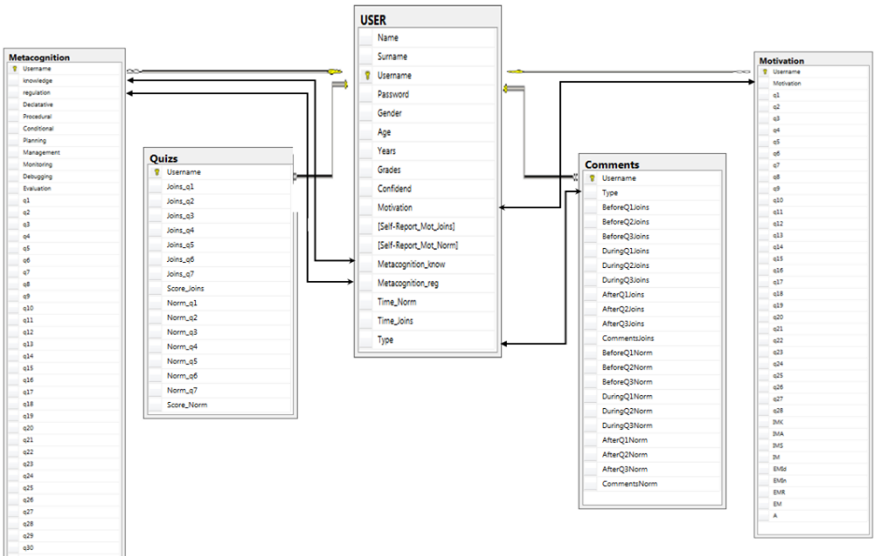


Figure 5 – Database Relations

3.4 Gaze Point

The Gazepoint Analysis system provides an easy-to-use yet powerful method for collecting and analyzing eye-gaze data. The GP3 is a research-grade eye tracker utilizing a 60Hz machine-vision camera at the heart of its imaging and processing system. There are two modes of operation in the software, data capture mode and data analysis mode. Standard operation which allows for basic screen capture with gaze overlay and is included with the purchase of a GP3 eye-tracker. The version of Analysis which enables text, image and video media playback, dynamic web analysis and dynamic Areas-Of-Interest (AOI's) with statistics.

When you create a new project the following files and folders are created:

- C:\"Path to Project"\NewProject.prj - The project file
- C:\"Path to Project"\user - The folder where recorded user data is saved
- C:\"Path to Project"\src - The folder for source media for playback
- C:\"Path to Project"\result - The folder where output result files are saved

A real-time display of the captured screen with gaze data is shown in the primary display window.

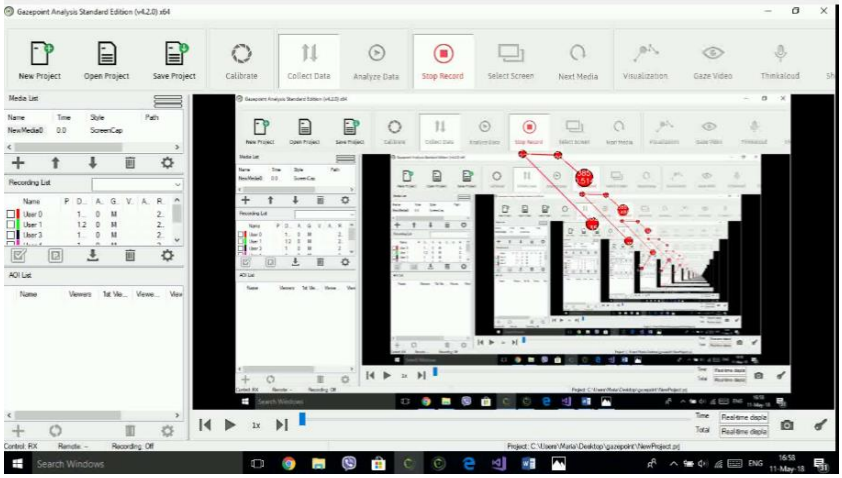
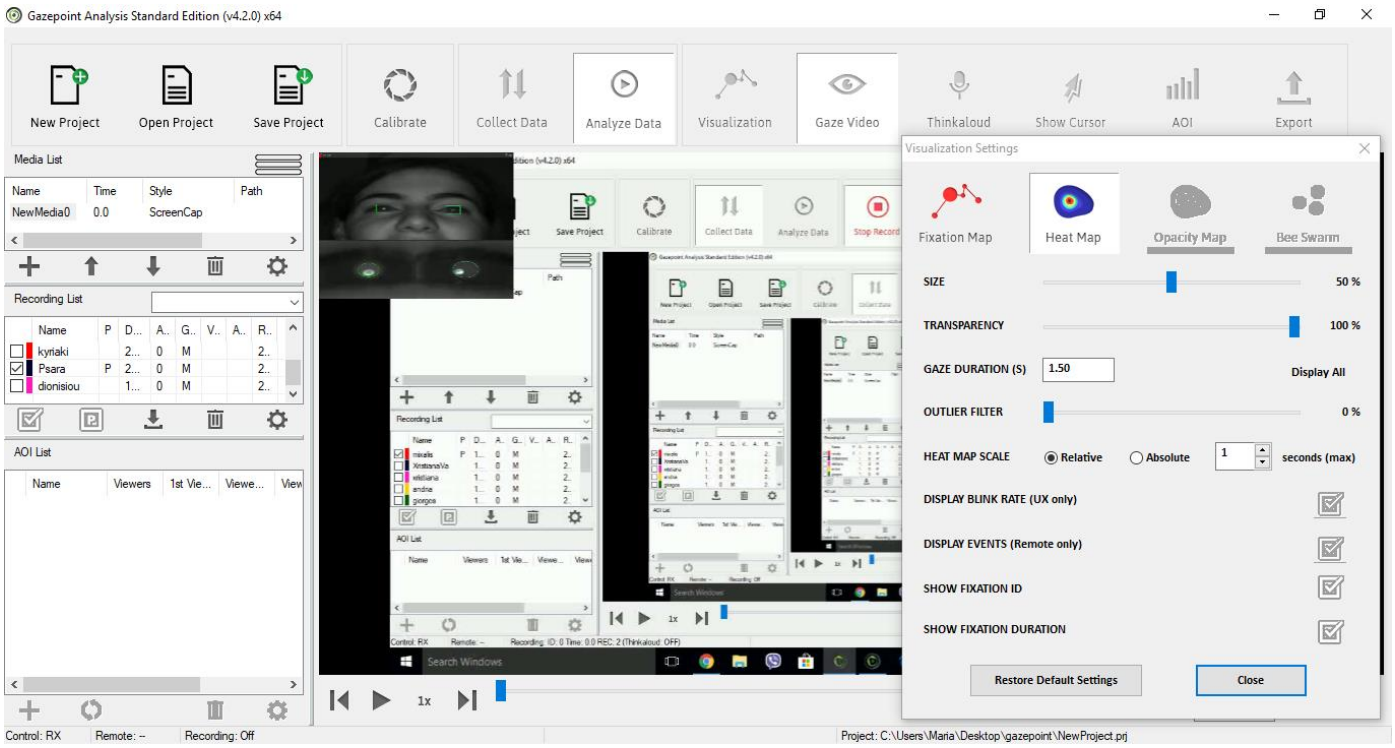


Figure 5 – Gaze Point Analysis Collect Data

Once data collection is complete, the recorded data may be exported in a variety of formats. The data analysis mode is active when the Analyze Data button is pressed. The control buttons are as follows

- Analyze Data: Enter data analysis mode
- Heatmap: Visualize the recorded gaze data as a heat map (click again for multiple heatmap styles)
- Fixationmap: Visualize the recorded gaze data as a fixation map
- Gaze Video: Display the users face as an overlay on the image
- Show Cursor: Display the users cursor position as an overlay on the image
- Show AOI: Display the AOI regions as an overlay on the image
- Export: Save the display output as a video, raw data as a CSV file and AOI statistics in the \result\ folder

For the current project for each user and each chapter we collect the count of fixations, the duration of the fixations, the fixations in area of interest(AOI) and the duration of the fixations in the AOI.



- Figure 5 – Gaze Point Analysis Analyze Data

Chapter 4

Development of System

4.1 Technologies and Tools for Creating InfoVisLearnning

4.1.1 Technologies for Creating InfoVisLearnning

ASP.NET is server-side technology. It was developed by Microsoft to allow programmers to build dynamic web sites, web applications and web services. ASP.NET is written using Object Oriented Programming languages such as C++, C#, or VB.net. During the time the page is running, it can execute any task; involve values, reading or updating database, or communication with other programs.

My web page is completed with the use Asp. My design implicates JavaScript, CSS and Html. Eventually, the code is writing in C# program language.

JavaScript is a scripting or programming language or dynamic programming language that allows you to implement complex things on web pages. Script language takes longer for processing but is practical and helpful for small programs. It cans be imbedded in HTML pages and interactive in Web browser. It is used to create effects within websites.

JavaScript improves the graphical interface and coding components in web pages. Following it is appropriate to create cause to exist the website with every detail.

Hypertext Markup Language (Html) is the basic markup language for devises, Web pages and Web applications. It is a scripting language, for this reason, the content of a website is defined by Html. It provides a means to design composition documents by structural semantics.
Beside JavaScript, the web page utilizes and HTML. This combination makes my website more efficiently.

Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a markup language like HTML. It is used for visual style and user interfaces in HTML. CSS adjusts different styles and methods in the same page and can display or resize the screen depending on the device. Also, it involves shadows, gradients, transitions and animations.
In my web page the CSS visual the user interface style.

ASP.NET AJAX Control Toolkit is an open-source project built on top of the Microsoft ASP.NET AJAX framework. It is a joint effort between Microsoft and the ASP.NET AJAX community that provides a powerful infrastructure to write reusable, customizable and extensible ASP.NET AJAX extenders and controls, as well as a rich array of controls that can be used out of the box to create an interactive Web experience. The AJAX Control Toolkit contains more than 30 controls that enable you to easily create rich, interactive web pages.
I use AJAX Control Toolkit to create an interactive website to measure participants motivation along the task.

C# is an object-oriented programming language developed by Microsoft. C# is a tool which Visual C# .NET uses. Visual C# .NET consists interfaces, visual designers, suitable code, XML Web services and database applications for Web applications based on C#. The main role of C# is making easy the implementation a web page.

InfoVisLearnign is developed in Asp.Net. Accordingly, C# is the language which manages the web pages and controls the data in Database SQL Server.

4.1.2 Tools for Creating InfoVisLearnning

IIS web server is the server where the application will be implemented. The web server is responsible for accepting requests from customers - users to serve them.

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop web sites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms. Visual Studio supports 36 different programming languages such as ASP.NET, C, C++, Visual Basic, C#, JavaScript, HTML and CSS. Finally, Visual Studio manages Microsoft SQL Server.
Visual Studio is the program which I use for deployment a web page because is convenient to build a dynamic website, on account of it provides combination betwixt design and code. Moreover, it proffers a manageable access in database.

4.2 SQL Server Database

Microsoft SQL Server is a database management system. It stores and retrieves data from other software applications across a network. A database is lists of values and attributes. Microsoft SQL Server provides an environment used to generate databases that can be accessed from workstations, the Internet, or other media such as a personal digital assistant.

In the implementation Microsoft SQL Server is indispensable tool owing to that is the storage which it cherishes and keeps values security and safe. Additionally, it is connected with website in which it has the accountability to save participant profile information and the metrics. Afterwards it has conjunction with web page which demonstrates the results from database to the administrator.

The system compel database to play dominant role due to it allows the flow of data from one component in other. An important aspect is that the database keeps the data secure and safe with appropriate manage. The SQL Server saves the personal information from profile the score from questionnaires, the time to each task, the motivation self-reporting and admin comments for metacognition. Beginning with the register of user, which save in table in SQL Server. After, everyone has to answer 2 questionnaires then all data store in 2 different tables in database and they are separated by the username of every person. Therefore, the user when login in the infoVisLearning environment first attends a lesson on relational algebra Joins either in lecture mode or infographics mode and change periodically his/her motivation. In database store the total time at this task the participants self-reporting motivation. When student feels ready has to do a test and the answers he has given are stored on the database. this process is also done for the normalization content. At the end the administrator saves at the database the comments from the observation and the answers for the think aloud protocol.

4.2.1 Store Data

Insert User:

```
CREATE PROCEDURE [dbo].[Insert_User]
       @Name NVARCHAR(15), @Surname NVARCHAR(20), @UserName NVARCHAR(10),
       @Password NVARCHAR(10),@Gender NCHAR(10), @Age INT,
       @Years INT, @Grades FLOAT, @Conf INT

AS
   BEGIN
       SET NOCOUNT ON;
       IF EXISTS(SELECT Username FROM [infovis].[USER] WHERE Username = @Username)
       BEGIN
              SELECT -1 -- Username exists.
       END

       ELSE
         BEGIN
              INSERT INTO [infovis].[USER]
              ([Name],[Surname],[Username],[Password],[Age],[Gender],[Years],
              [Grades],[Confidend])
              VALUES (@Name,@Surname,@UserName,@Password,@Age,@Gender,
              @Years,@Grades,@Conf)

              SELECT 0 -- UserId
     END
END
```

This is the stored procedure for user insertion. If the username already exists to the database, then the procedure returns the value -1. Otherwise store the user's profile information to the array USER and return the value 0. All the other procedures for insert to database are implemented in a similar way.

User Login:

```
CREATE PROCEDURE [dbo].[Login_User]
	@UserName NVARCHAR(10),@Password NVARCHAR(10)
AS BEGIN
	SET NOCOUNT ON;
	IF NOT EXISTS (SELECT Username FROM [infovis].[USER] WHERE Username =
@Username)
	BEGIN
		SELECT -1 --Username doesn't exist
	END
		ELSE IF EXISTS (SELECT Username FROM [infovis].[USER] WHERE Username =
	@Username and Password=@Password)
	BEGIN
		SELECT -0 --Connect
	END
	ELSE
	BEGIN
		SELECT -2
	END
END
```

This is the stored procedure for user login. If a user inserts a name that not exist in the table then the procedure returns the value -1. If the username exists and the password user inserts matches then the procedure returns the value 0 otherwise, returns the value -2.

Show All:

```
create PROCEDURE [dbo].[Show_All1]

AS
BEGIN
	select U.Username, U.Age, u.Gender, u.Grades, u.Confidend, u.Years,
	u.Motivation, mo.A, mo.EM, mo.EMId, mo.EMIn, mo.EMR, mo.IM, mo.IMA, mo.IMK,
	mo.IMS,
	u.Metacognition_know, me.Declatative, me.Procedural, me.Conditional,
	u.Metacognition_reg, me.Planning, me.Management, me.Monitoring, me.Debugging,
	me.Evaluation,
	u.Type, u.Time_Joins, q.Score_Joins, u.Time_Norm, q.Score_Norm
	from [infovis].[USER] As U
	Inner Join [infovis].[Motivation] As Mo On U.Username = Mo.Username
	Inner Join [infovis].[Metacognition] As Me On U.Username = Me.Username
	Inner Join [infovis].[Quizs] As Q On U.Username = Q.Username
```

```
END
```

This is the stored procedure for show for the presentation of the results. It is a query where the relations User Motivation, Metacognition and Quiz are joined based on Username. In this procedure we select some attributes from those 4 table to project. All the other procedures for represent our results to the administrator are implemented in a similar way.

4.3 User Interface for InfoVisLearning

For the experiment, we created an online system where we could connect the participants and get the measurements we needed.

4.3.1 User Interface

To get the user into the system must create their own profile. Firstly, system asks the users to give some demographics such as name, gender, age and year of study. Furthermore, the system asks the users to give some information about Databases like their grades their degree at the relevant course and how well the think they know databases.

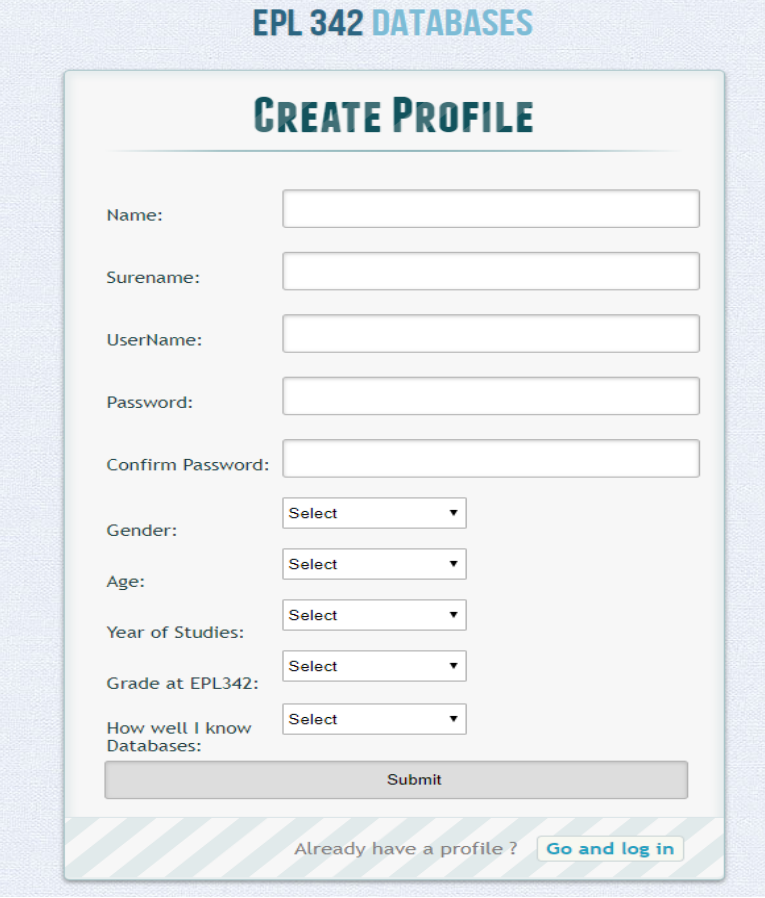
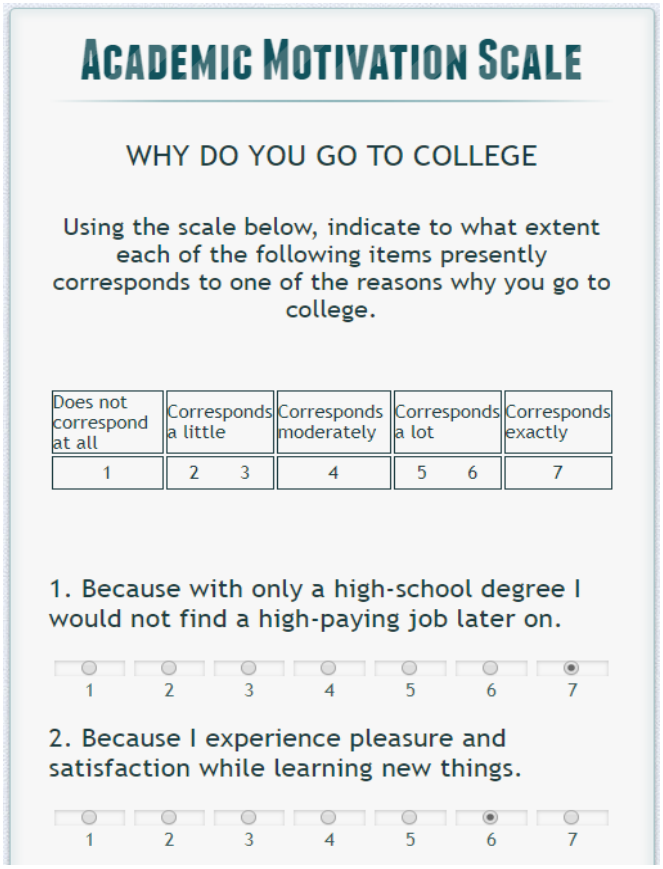


Image 3 – Create Profile Page

Then, users to complete their profile they have to complete 2 questionnaires. The Academic Motivation Scale (AMS) questionnaire which measures the motivation level why this specific user goes to college. Finally, the Metacognitive Awareness Inventory (MAI) which measures participant metacognition (know about cognition and regulation for cognition).



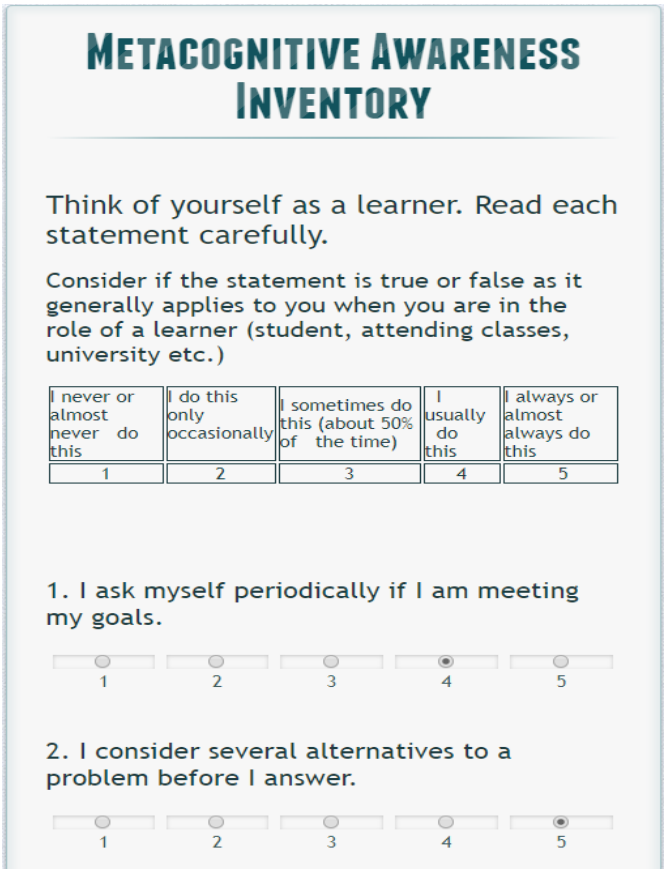
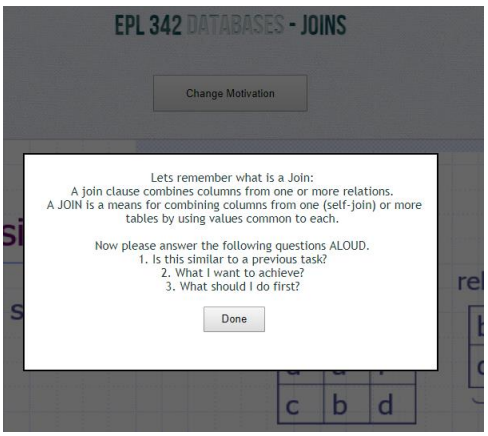


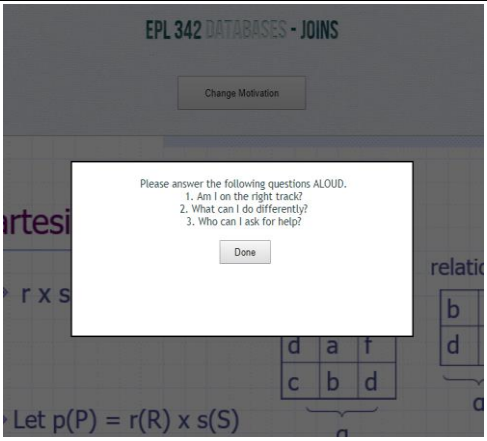
Image 4 – Academic Motivation Scale Questionnaire Page

Image 5 – Metacognitive Awareness Inventory Page

When the user completes his profile, he can sing in to the system. Once the user logs in, he/she sees an introductory screen explaining to him/her what follow. Informs the user that we will use the Think Aloud Protocol and so urge him/her to say out loud his/her thoughts. He/her must answers 3 questions before starts reading, during he/she is reading and after he/she finishes reading the content. It also asks the user to declare how much motivated he/she feels and change this several times during he/she is reading the content about Join and Normalization. The user informs that he/she will studies 2 chapter from the course EPL342 Joins and Normalization. The content will represent with 2 different way. How the material will be presented is decided randomly for each user, the one chapter is using course traditional slides and the other is using more visual form of the lecture.

When the user proceeds to the first chapter, he / she has to answer questions about the procedure that will follow to read. After answering the questions indicate how motivated they feel about what they do. In the middle of the reading process, the user has to answer 3 more questions about how he reads and if this strategy brings the desire result and if he/she can do something different. During the hole process the participants indicates his/her motivational level. At the end of the reading process, the individual has to answer 3 last question to evaluate if the strategy he/she used works.





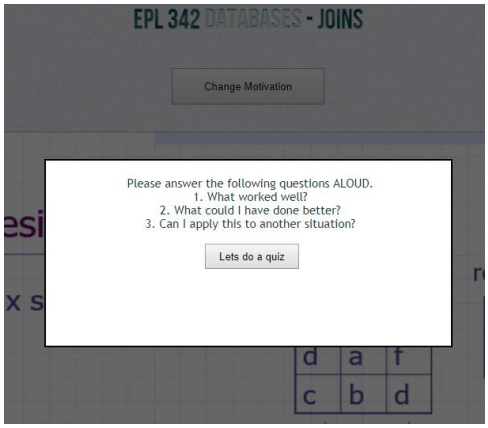


Image 6 – Questions Before Start Reading

Image 7 – Questions During Reading

Image 8 – Questions After Reading

Image 9 – Self-Reporting Motivation

The same process is also followed for the chapter of Normalization. The user has to answer the same questions before, during and after reading for Normalization. Likewise, at joins chapter the individual must declare his/her motivational level and change it through reading for normalization. After each chapter, the user must answer a small quiz related to the material previously read to give him/her a motivation to read more carefully and to see what he/she learned.

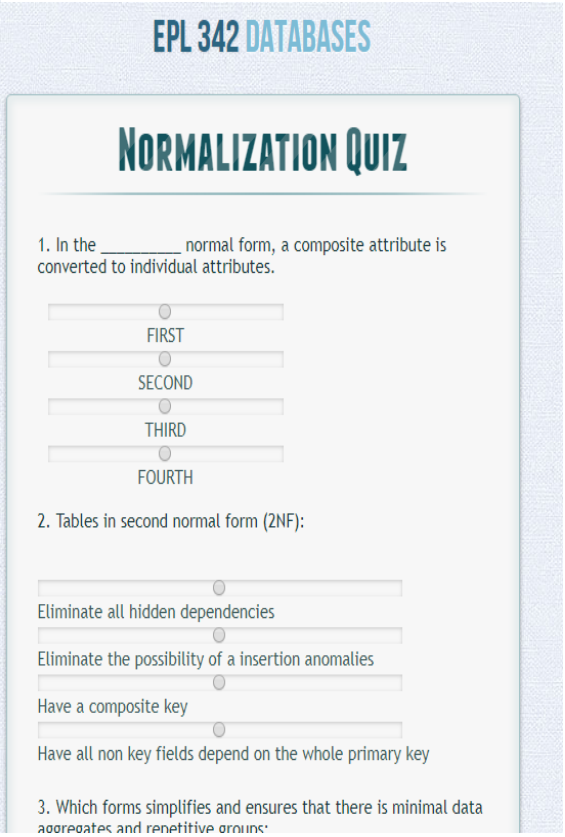


Image 10 – Page for Joins' Quiz

Image 11 – Page for Normalization's Quiz

4.3.2 Administrator Interface

When the system administrator logged in has the ability to do different tasks. First, admin can enter the comments he/she has received from the Think Aloud protocol from each participant. In this page, admin choose from a list the username for which it will import the data, the chapter which concern the comments and the way in which it is presented the material about the chapter. It can also add the answer to the question of the metacognition that occurred before, during and after of the participant's reading. Finally, he/she can add general comments from him/her observation during the experiment.

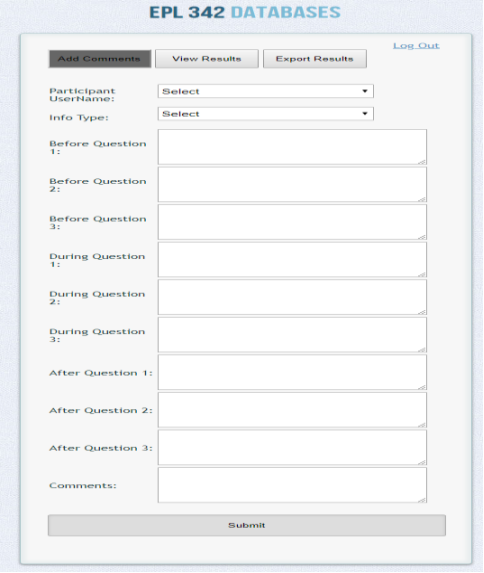


Image 12 – Admin Add Comment Page

Additionally, the user has the ability to see the results of the experiment, and to extract the data to an excel file. Admin has the options for what data he/she want to see or export. He/she may choose to see user profiles, data from the motivation questionnaire with the self-reporting motivation for every user and data from metacognition questionnaire with the comments from Think Aloud Protocol. He/she can also see user profile information and the results from the quiz as well as each table separately and all the table combined.

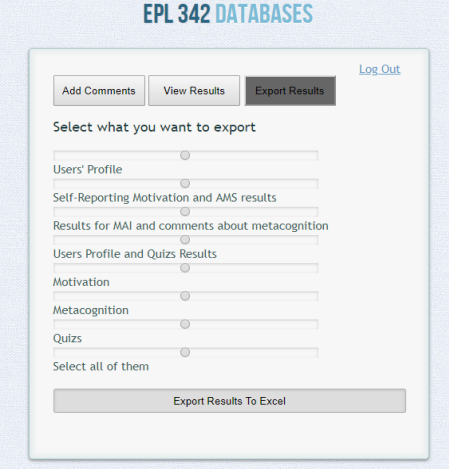


Image 13 – Admin Export Results Page

Image 14 – Admin View Results Page

Administrator has the chance to see the results at the site. Admin can see bar chart for the time and score for each user at the 2 chapters. Furthermore, admin can see bar charts for the motivation and the metacognition about knowledge and metacognition for regulation for each user.

Chapter 5

Experiment

5.1 Procedure

For this study, we first asked participants to create their profile by giving some demographics information about them as well as their grades in the EPL342 and how well they feel about databases. Then, they have to answer 2 questionnaires one to measure their motivation and one to measure their metacognition. Once the user's profile is over, then he/she login to the system, and reads instructions about what it’s follow. Every user belongs to one group, first group has the participants that read join using lecture’s mode and normalization using infographic. Second group belong the participants which read join using infographic and normalization using lecture. During the reading process we used think aloud protocol. Think aloud protocols consist of observing a user working with the while encouraging them to "think-aloud"; to say what they are thinking and wondering at each moment.

They started by reading the chapter about Join if they belonged to group 1 they saw lecture or if they belonged to group 2 they saw infographics. Before they started reading, the read the definition of join and they had to answer 3 questions about the strategy they use for studying. After this, they had to declare how motivated they felt about what they were doing. During they were studying, they had to answer 3 more question about how well the strategy worked and if they could do something different. Then, they must declare again how motivated the felt. Finally, when they felt they are ready they declared their motivation for

the last time and answered 3 more questions to evaluate if the strategy the used worked and what was helpful for them.

The same procedure is followed for Normalization chapter, the individuals had to answer the same 3 questions before started to read, the same 3 questions during reading and 3 questions after they finished. The participants must to declare their motivation before, during and at the when they finished. After, they answered the last 3 questions for each chapter they do a small quiz with 7 multiple choice questions about what they read.

The hole process is captured from the eye-tracking, so we can use some metrics for the analysis. For the eye-tracking we use the count of total fixations, the count of total fixation in area of interest and duration of total fixations and duration of total fixations in area of interest. Eye fixation is one of the foremost components of effective reading. In simple terms, eye fixation refers to the point where your eyes take a rest during the reading process. People who tend to make less eye fixations during reading usually have a higher reading speed as compared to people who make frequent eye fixations.

5.2 Participants

Participants (N=20) ranged in age from 20 to 24. There were approximately the same number of males (50%) as females (50%). All the participants were computer science students, at their third or fourth year of studies. All the participants attend the course of Databases. The grades of the participants range from 5.5 to 8.5, there are 5 participants with grade 5.5 (25%), 1 with 6 (5%), 3 with 6.5 (15%), 2 with 7 (10%), 4 with 7.5 (20%), 2 with 8 (10%) and 3 with 8.5 (15%).

5.3 Data Analysis

5.1.1 Statistical Analysis

We found the following results from the experimental analysis we did using Pearson correlation:

1. Significant negative correlation between metacognition's subscale Knowledge about Cognition and Amotivation.
2. Significant negative correlation between metacognition's subscale Regulation for Cognition and Amotivation.
3. Motivation is correlated with Intrinsic Motivation, Extrinsic Motivation and negative correlated with Amotivation.
4. Confident is correlated with Motivation, first Self-Reporting Motivation at Join and Normalization chapter.

The negative relationship between metacognitive subscales and Amotivation was expected. We know that amotivation is the lack of motivation and metacognition is the knowledge about own's cognitive process. So, if someone feels frustrated about his/her own cognitive process, then there is more likely to avoid involving to a new task due the lack of motivation.

Motivation is also related with Intrinsic and Extrinsic and that's perfectly reasonable since motivation is defined as the sum up of intrinsic motivations and extrinsic motivations. Amotivation is the lack of motivation hence the negative correlation with Motivation.

"Motivation is the effort, the drive, the desire, and the energy a person uses to activate and maintain goal driven behavior." as Murray Johannsen said. So, the correlation between how confident individual felt for Databases course and motivation was expected too. By the same reasoning, the self-reporting motivation for the 2 chapters are correlated with how confident the felt.

Correlations

		Metacognition_know	Metacognition_reg	Motivation	A	EM	IM
Metacognition_know	Pearson Correlation	1	.816**	.266	-.616**	.100	.387
	Sig. (2-tailed)		.000	.256	.004	.675	.092
	N	20	20	20	20	20	20
Metacognition_reg	Pearson Correlation	.816**	1	.395	-.610**	.200	.519*
	Sig. (2-tailed)	.000		.085	.004	.397	.019
	N	20	20	20	20	20	20
Motivation	Pearson Correlation	.266	.395	1	-.480*	.909**	.903**
	Sig. (2-tailed)	.256	.085		.032	.000	.000
	N	20	20	20	20	20	20
A	Pearson Correlation	-.616**	-.610**	-.480*	1	-.234	-.640**
	Sig. (2-tailed)	.004	.004	.032		.321	.002
	N	20	20	20	20	20	20
EM	Pearson Correlation	.100	.200	.909**	-.234	1	.642**
	Sig. (2-tailed)	.675	.397	.000	.321		.002
	N	20	20	20	20	20	20
IM	Pearson Correlation	.387	.519*	.903**	-.640**	.642**	1
	Sig. (2-tailed)	.092	.019	.000	.002	.002	
	N	20	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 1 – Metacognition – Motivation

Correlations

		Confidend	Motivation	A	Self-Report_Mot_Joins_1	Self-Report_Mot_Norm_1
Confidend	Pearson Correlation	1	.456*	-.031	.463*	.603**
	Sig. (2-tailed)		.043	.896	.040	.005
	N	20	20	20	20	20
Motivation	Pearson Correlation	.456*	1	-.480*	.119	.486*
	Sig. (2-tailed)	.043		.032	.617	.030
	N	20	20	20	20	20
A	Pearson Correlation	-.031	-.480*	1	.062	-.155
	Sig. (2-tailed)	.896	.032		.796	.514
	N	20	20	20	20	20
Self-Report_Mot_Joins_1	Pearson Correlation	.463*	.119	.062	1	.259
	Sig. (2-tailed)	.040	.617	.796		.270
	N	20	20	20	20	20
Self-Report_Mot_Norm_1	Pearson Correlation	.603**	.486*	-.155	.259	1
	Sig. (2-tailed)	.005	.030	.514	.270	
	N	20	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2- Confident – Motivation

5. Significant correlation between Time an individual spent at Join chapter and the total fixation had at this time. Also, time related with the total fixation not at the area of interest. Those correlations concern the participants for the group which saw the Join at slide mode.
6. Significant correlation between Total fixations with total fixations in AOI and total fixation not in AOI for the 2 groups.

These correlations show us that for the group which saw the lectures for joins, the more time they spent to read, the more fixations they did. Also, they did more fixations out of the area of interest. This tell us that those whose saw lecture made more wasted fixations during the time. All the participants regardless of the group they belonged to the more fixation the made, the more fixation the made out of the area of interest. This is perfectly reasonable since the more fixation you made you the more fixation you made in area of interest or out. As a conclusion, we can say that participants who used lecture for Join chapter they wasted more time to read the all content, since they spent more time watching out of the area of interest.

Correlations

Type			Time_Joins	Join_Total_fixation	Join_Total_fixation_inAOI	Total_lost_fixation_Join
1	Time_Joins	Pearson Correlation	1	.633*	.350	.738*
		Sig. (2-tailed)		.050	.321	.015
		N	10	10	10	10
	Join_Total_fixation	Pearson Correlation	.633*	1	.860**	.850**
		Sig. (2-tailed)	.050		.001	.002
		N	10	10	10	10
	Join_Total_fixation_inAOI	Pearson Correlation	.350	.860**	1	.462
		Sig. (2-tailed)	.321	.001		.178
		N	10	10	10	10
	Total_lost_fixation_Join	Pearson Correlation	.738*	.850**	.462	1
		Sig. (2-tailed)	.015	.002	.178	
		N	10	10	10	10
2	Time_Joins	Pearson Correlation	1	.589	.435	.519
		Sig. (2-tailed)		.073	.209	.124
		N	10	10	10	10
	Join_Total_fixation	Pearson Correlation	.589	1	.878**	.665*
		Sig. (2-tailed)	.073		.001	.036
		N	10	10	10	10
	Join_Total_fixation_inAOI	Pearson Correlation	.435	.878**	1	.227
		Sig. (2-tailed)	.209	.001		.529
		N	10	10	10	10
	Total_lost_fixation_Join	Pearson Correlation	.519	.665*	.227	1
		Sig. (2-tailed)	.124	.036	.529	
		N	10	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3 – Time Correlations at Joins

7. Significant correlation between total fixations and total fixations int the area of interest. Those correlations concern the participants for the 2 groups.

8. Significant correlation between Time an individual spent at Normalization chapter and the total fixation had at this time. Also, time related with the total fixation at the area of interest. Those correlations concern the participants for the group which saw the Normalization at slide mode.

These correlations show us that for the 2 groups which read for normalization, the more fixation they made, the more fixations in area of interest they did. The participants of

group 2 who saw the infographic about Normalization the more fixation the made or the more fixation the made in the area of interest, the more time they spend to read the content. We conclude that participants of group 1 needed more time and more fixations to understand the content.

Correlations

Type			Time_Norm	Norm_Total_fixation	Norm_Total_fixation_inAOI	Total_lost_Fix_Norm
1	Time_Norm	Pearson Correlation	1	-.062	-.448	.474
		Sig. (2-tailed)		.865	.194	.166
		N	10	10	10	10
	Norm_Total_fixation	Pearson Correlation	-.062	1	.675*	.418
		Sig. (2-tailed)	.865		.032	.229
		N	10	10	10	10
	Norm_Total_fixation_inAOI	Pearson Correlation	-.448	.675*	1	-.389
		Sig. (2-tailed)	.194	.032		.267
		N	10	10	10	10
	Total_lost_Fix_Norm	Pearson Correlation	.474	.418	-.389	1
		Sig. (2-tailed)	.166	.229	.267	
		N	10	10	10	10
2	Time_Norm	Pearson Correlation	1	.787**	.644*	.235
		Sig. (2-tailed)		.007	.045	.513
		N	10	10	10	10
	Norm_Total_fixation	Pearson Correlation	.787**	1	.819**	.297
		Sig. (2-tailed)	.007		.004	.404
		N	10	10	10	10
	Norm_Total_fixation_inAOI	Pearson Correlation	.644*	.819**	1	-.305
		Sig. (2-tailed)	.045	.004		.392
		N	10	10	10	10
	Total_lost_Fix_Norm	Pearson Correlation	.235	.297	-.305	1
		Sig. (2-tailed)	.513	.404	.392	
		N	10	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 – Time Correlations at Normalization

9. There is significant correlation between the way the content of Joins represented and the score at the quiz. But there is no significant correlation with the time an individual spent to read the content of Joins.
10. There is no significant correlation between the way the content of Joins represented, the time sent to read the content and the score at the quiz.

Correlations

		Type	Time_Norm	Score_Norm
Type	Pearson Correlation	1	.432	.345
	Sig. (2-tailed)		.057	.136
	N	20	20	20
Time_Norm	Pearson Correlation	.432	1	-.179
	Sig. (2-tailed)	.057		.449
	N	20	20	20
Score_Norm	Pearson Correlation	.345	-.179	1
	Sig. (2-tailed)	.136	.449	
	N	20	20	20

Correlations

		Type	Time_Joins	Score_Joins
Type	Pearson Correlation	1	-.159	.476*
	Sig. (2-tailed)		.503	.034
	N	20	20	20
Time_Joins	Pearson Correlation	-.159	1	-.318
	Sig. (2-tailed)	.503		.171
	N	20	20	20
Score_Joins	Pearson Correlation	.476*	-.318	1
	Sig. (2-tailed)	.034	.171	
	N	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5 – Type Correlations at Normalization

Table 6 – Type Correlations at Joins

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11. Significant correlation between fixation in AOI and score to the quiz at Normalization chapter for participants who saw infographic. But there is no significant correlation with score and fixations for those who saw lectures.
12. No significant correlation between score and fixation at the chapter of Joins.

Correlations

Type			Score_Joins	Join_Total_fixation	Join_Total_fixation_inAOI
1	Score_Joins	Pearson Correlation	1	-.217	.019
		Sig. (2-tailed)		.548	.960
		N	10	10	10
	Join_Total_fixation	Pearson Correlation	-.217	1	.860**
		Sig. (2-tailed)	.548		.001
		N	10	10	10
	Join_Total_fixation_inAOI	Pearson Correlation	.019	.860**	1
		Sig. (2-tailed)	.960	.001	
		N	10	10	10
2	Score_Joins	Pearson Correlation	1	.545	.610
		Sig. (2-tailed)		.104	.061
		N	10	10	10
	Join_Total_fixation	Pearson Correlation	.545	1	.878**
		Sig. (2-tailed)	.104		.001
		N	10	10	10
	Join_Total_fixation_inAOI	Pearson Correlation	.610	.878**	1
		Sig. (2-tailed)	.061	.001	
		N	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

Type			Score_Norm	Norm_Total_fixation	Norm_Total_fixation_inAOI
1	Score_Norm	Pearson Correlation	1	.382	.692*
		Sig. (2-tailed)		.277	.027
		N	10	10	10
	Norm_Total_fixation	Pearson Correlation	.382	1	.675*
		Sig. (2-tailed)	.277		.032
		N	10	10	10
	Norm_Total_fixation_inAOI	Pearson Correlation	.692*	.675*	1
		Sig. (2-tailed)	.027	.032	
		N	10	10	10
2	Score_Norm	Pearson Correlation	1	-.100	-.097
		Sig. (2-tailed)		.784	.791
		N	10	10	10
	Norm_Total_fixation	Pearson Correlation	-.100	1	.819**
		Sig. (2-tailed)	.784		.004
		N	10	10	10
	Norm_Total_fixation_inAOI	Pearson Correlation	-.097	.819**	1
		Sig. (2-tailed)	.791	.004	
		N	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 – Score Correlations at Joins

Table 8 – Score Correlations at Normalization

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13. No significant correlation between the 2 subscales of Metacognition and the time needed to read Join or the score to the quiz for the 2 way the material is represented.
14. No significant correlation between the 2 subscales of Metacognition and the time needed to read Normalization or the score to the quiz for the 2 way the material is represented.

Correlations

Type			Metacognition_know	Metacognition_reg	Time_Joins	Score_Joins
1	Metacognition_know	Pearson Correlation	1	.798**	.416	-.265
		Sig. (2-tailed)		.006	.231	.459
		N	10	10	10	10
	Metacognition_reg	Pearson Correlation	.798**	1	.274	-.049
		Sig. (2-tailed)	.006		.444	.894
		N	10	10	10	10
	Time_Joins	Pearson Correlation	.416	.274	1	-.644*
		Sig. (2-tailed)	.231	.444		.044
		N	10	10	10	10
	Score_Joins	Pearson Correlation	-.265	-.049	-.644*	1
		Sig. (2-tailed)	.459	.894	.044	
		N	10	10	10	10
2	Metacognition_know	Pearson Correlation	1	.885**	-.339	-.146
		Sig. (2-tailed)		.001	.338	.688
		N	10	10	10	10
	Metacognition_reg	Pearson Correlation	.885**	1	-.289	.013
		Sig. (2-tailed)	.001		.417	.972
		N	10	10	10	10
	Time_Joins	Pearson Correlation	-.339	-.289	1	.408
		Sig. (2-tailed)	.338	.417		.242
		N	10	10	10	10
	Score_Joins	Pearson Correlation	-.146	.013	.408	1
		Sig. (2-tailed)	.688	.972	.242	
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 9 – Metacognition Correlations Joins

Correlations

Type			Metacognition_know	Metacognition_reg	Time_Norm	Score_Norm
1	Metacognition_know	Pearson Correlation	1	.798**	.043	.082
		Sig. (2-tailed)		.006	.907	.821
		N	10	10	10	10
	Metacognition_reg	Pearson Correlation	.798**	1	-.021	-.015
		Sig. (2-tailed)	.006		.954	.967
		N	10	10	10	10
	Time_Norm	Pearson Correlation	.043	-.021	1	-.599
		Sig. (2-tailed)	.907	.954		.067
		N	10	10	10	10
	Score_Norm	Pearson Correlation	.082	-.015	-.599	1
		Sig. (2-tailed)	.821	.967	.067	
		N	10	10	10	10
2	Metacognition_know	Pearson Correlation	1	.885**	-.458	-.320
		Sig. (2-tailed)		.001	.183	.367
		N	10	10	10	10
	Metacognition_reg	Pearson Correlation	.885**	1	-.291	-.232
		Sig. (2-tailed)	.001		.414	.519
		N	10	10	10	10
	Time_Norm	Pearson Correlation	-.458	-.291	1	-.196
		Sig. (2-tailed)	.183	.414		.588
		N	10	10	10	10
	Score_Norm	Pearson Correlation	-.320	-.232	-.196	1
		Sig. (2-tailed)	.367	.519	.588	
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10 – Metacognition Correlations Normalization

Using Independent T- test we saw the means for time and score at Join and Normalization chapter. The means for time spend an individual and score at Join chapter is 11.369 sec, 63/100 for group who saw lectures and 10.556 sec and 82/100 for group who saw infographic. The means for time spend an individual and score at Normalization chapter is 12.756 sec, 49/100 for group who saw lectures and 15.512 sec and 61/100 for group who saw infographic.

From the T-test results' we can conclude that there is a statistically significant difference between the mean number for score at joins for the 2 groups. A value is less than .05 means and that variability in our two conditions is not the same. The scores in one condition vary much more than the scores in the second condition. This is show us that the way the material is represented for the Join chapter influence the score ate quiz. The participants which saw the lecture mode had lower score than the participants that saw the infographic for this chapter.

There is already a statistically difference between the mean number of time at the time individuals spent to read the chapter of Normalization. This difference is not significant (sig. =0.057> 0.05) maybe because of the small sample. But this difference shows us that the way the material is represented for the Normalization chapter influence the time individuals spent to read the content. The participants which saw the lecture mode need more time to read than the participants that saw the infographic for this chapter.

Group Statistics

	Type	N	Mean	Std. Deviation	Std. Error Mean
Time_Joins	1	10	11.36873532	3.263223829	1.031921982
	2	10	10.55557727	1.875318415	.5930277529
Score_Joins	1	10	63.00	19.465	6.155
	2	10	82.00	17.512	5.538
Score_Norm	1	10	49.00	17.448	5.518
	2	10	61.00	16.964	5.364
Time_Norm	1	10	12.75751470	2.857785677	.9037111804
	2	10	15.51191450	3.190160336	1.008817276

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Time_Joins	Equal variances assumed	7.039	.016	.683	18	.503	.8131580507	1.190186915	-1.68733187	3.313647972
	Equal variances not assumed			.683	14.360	.505	.8131580507	1.190186915	-1.73354737	3.359863475
Score_Joins	Equal variances assumed	.614	.444	-2.295	18	.034	-19.000	8.280	-36.395	-1.605
	Equal variances not assumed			-2.295	17.802	.034	-19.000	8.280	-36.409	-1.591
Score_Norm	Equal variances assumed	.057	.814	-1.559	18	.136	-12.000	7.696	-28.168	4.168
	Equal variances not assumed			-1.559	17.986	.136	-12.000	7.696	-28.169	4.169
Time_Norm	Equal variances assumed	.448	.512	-2.034	18	.057	-2.75439980	1.354402523	-5.59989391	.0910943154
	Equal variances not assumed			-2.034	17.786	.057	-2.75439980	1.354402523	-5.60234514	.0935455440

Table 11 – T-Test

From the T-test results' we can conclude that there is a statistically significant difference between the mean number for self-reporting motivation at joins for the 2 groups. A value is less than .05 means and that variability in our two conditions is not the same. This is show us that the way the material is represented for the Join chapter influence the student. The participants which saw the infographic mode were more motivated than the participants that saw the infographics for this chapter.

There is no significant statistically difference between the mean number of self-reporting motivation at Normalization chapter.

Group Statistics

	Type	N	Mean	Std. Deviation	Std. Error Mean
Self-Report_Mot_Joins_1	1	10	3.80	1.398	.442
	2	10	5.40	.966	.306
Self-Report_Mot_Joins_2	1	10	3.50	1.650	.522
	2	10	5.10	1.197	.379
Self-Report_Mot_Joins_3	1	10	3.10	1.912	.605
	2	10	5.00	1.247	.394

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Self-Report_Mot_Joins_1	Equal variances assumed	.750	.398	-2.977	18	.008	-1.600	.537	-2.729	-.471
	Equal variances not assumed			-2.977	15.997	.009	-1.600	.537	-2.739	-.461
Self-Report_Mot_Joins_2	Equal variances assumed	1.000	.331	-2.482	18	.023	-1.600	.645	-2.954	-.246
	Equal variances not assumed			-2.482	16.420	.024	-1.600	.645	-2.964	-.236
Self-Report_Mot_Joins_3	Equal variances assumed	1.991	.175	-2.632	18	.017	-1.900	.722	-3.417	-.383
	Equal variances not assumed			-2.632	15.485	.018	-1.900	.722	-3.434	-.366

Group Statistics

	Type	N	Mean	Std. Deviation	Std. Error Mean
Self-Report_Mot_Norm_1	1	10	4.50	1.900	.601
	2	10	3.90	.994	.314
Self-Report_Mot_Norm_2	1	10	4.00	1.491	.471
	2	10	3.20	1.549	.490
Self-Report_Mot_Norm_3	1	10	3.90	1.595	.504
	2	10	2.60	1.430	.452

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Self-Report_Mot_Norm_1	Equal variances assumed	6.448	.021	.885	18	.388	.600	.678	-.825	2.025
	Equal variances not assumed			.885	13.585	.392	.600	.678	-.859	2.059
Self-Report_Mot_Norm_2	Equal variances assumed	.012	.913	1.177	18	.255	.800	.680	-.628	2.228
	Equal variances not assumed			1.177	17.973	.255	.800	.680	-.629	2.229
Self-Report_Mot_Norm_3	Equal variances assumed	.137	.716	1.919	18	.071	1.300	.677	-.123	2.723
	Equal variances not assumed			1.919	17.789	.071	1.300	.677	-.124	2.724

Table 12 – T-Test Motivation Joins

Table 13 – T-Test Motivation Normalization

Using regression, we find the following results:

1. For the coef. Column we can see if the metacognition increases the time a participant need decrease, but is motivation is increase the time increase too.
2. For the time needed to read join chapter we discover that the self-reporting motivation 1 and 2, total fixations are statistically significant because |p| is smaller than 0.05.

For these results we can say if we know the self-reporting motivation and metacognition we can predict the time a participant need to read. The r-square explain that the percentage of the variation for the time_join explained from the other variables by 87%.

```
. reg Time_Joins  Metacognition_know Metacognition_reg Type SelfReport_Mot_Joins_1 SelfReport_Mot_Joins_2 SelfRepo
> rt_Mot_Joins_3 Join_Total_fixation_inAOI Join_Total_fixation Motivation Confidend ,r

Linear regression                               Number of obs     =         20
                                                F(10, 9)          =      39.37
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8746
                                                Root MSE          =     1.3498

------------------------------------------------------------------------------
             |               Robust
  Time_Joins |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Metacognitio~w |  -.0245586   .0715279    -0.34   0.739    -.1863659    .1372488
Metacognitio~g |  -.0510074   .0480081    -1.06   0.316    -.1596093    .0575946
          Type |   3.430314   1.690652     2.03   0.073    -.3942059    7.254834
SelfReport_M~1 |  -2.084143   .3841374    -5.43   0.000    -2.953122   -1.215164
SelfReport_M~2 |   3.164123   .9200865     3.44   0.007     1.082743    5.245504
SelfReport_M~3 |  -1.293134   .6938174    -1.86   0.095    -2.862658    .2763901
Join_Total_f~I |  -.0111706   .0058197    -1.92   0.087    -.0243356    .0019944
Join_Total_f~n |   .0095683   .0031324     3.05   0.014     .0024823    .0166542
    Motivation |   .0556845   .0255018     2.18   0.057    -.0020045    .1133735
     Confidend |  -.6720398   .3590415    -1.87   0.094    -1.484248    .1401685
         _cons |   7.618251   4.388965     1.74   0.117    -2.310277    17.54678
------------------------------------------------------------------------------

. test Metacognition_reg Metacognition_know

 ( 1)  Metacognition_reg = 0
 ( 2)  Metacognition_know = 0

       F(  2,     9) =    4.24
            Prob > F =    0.0503
```

Table 14 – Time_Joins Regression

3. For the coef. Column we can see if the metacognition or motivation increases the time a participant needs decrease.
4. For the time needed to read normalizaton chapter we discover that the self-reporting motivation 3 and the type which the material is represented are statistically significant because |p| is smaller than 0.05.

For these results we can say if we know the self-reporting motivation at the end of the reading process and type of the way the content is represented we can predict the time a participant need to read. The r-square explain that the percentage of the variation for the time_norm explained from the other variables by 72%.

Source	SS	df	MS
Model	145.890237	11	13.2627488
Residual	57.1399118	8	7.14248898
Total	203.030149	19	10.6857973

Number of obs	= 20
F(11, 8)	= 1.86
Prob > F	= 0.1946
R-squared	= 0.7186
Adj R-squared	= 0.3316
Root MSE	= 2.6725

Time_Norm	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Age	1.356451	.812358	1.67	0.134	-.5168498	3.229752
Gender	-8.06318	2.975339	-2.71	0.027	-14.92432	-1.202036
Confidend	-1.070425	.9173782	-1.17	0.277	-3.185902	1.045053
Motivation	-.036402	.0665987	-0.55	0.600	-.1899789	.117175
Metacognition_know	-.2512377	.2060349	-1.22	0.257	-.726355	.2238796
Metacognition_reg	.1783506	.1118543	1.59	0.149	-.0795858	.436287
Type	5.90625	2.02132	2.92	0.019	1.245078	10.56742
SelfReport_Mot_Norm_1	-1.026164	1.198038	-0.86	0.417	-3.788844	1.736517
SelfReport_Mot_Norm_2	.1896817	1.301486	0.15	0.888	-2.811551	3.190915
SelfReport_Mot_Norm_3	2.629592	1.050557	2.50	0.037	.2070042	5.05218
Norm_Total_fixation_inAOI	.006735	.003503	1.92	0.091	-.0013428	.0148128
_cons	-28.4808	20.06712	-1.42	0.194	-74.75566	17.79406

Table 15 – Time_Norm Regression

5.1.2 Qualitative Analysis

From the answer we got using the Think Aloud Protocol we reached some conclusions. In both tasks, we asked the participants to answer the same questions before, during and after reading the content. In the experiment there were 2 different groups, the first group studied the Join chapter using slides and the Normalization chapter using infoVis and the second the reverse.

Join Chapter

Before:

Q1: Is this similar to a previous task?

The answers were the same for both groups all remembered seeing this chapter in lesson EPL342.

Q2: What do I want to achieve?

And in this question the answers were the same for both groups since everyone wanted to read them to remember them.

Q3: What should I do first?

The most common answer for the both groups at this question was to read the content serially.

During:

Q1: Am on the right track?

In group 1 more than half how they think they did not understand. Instead, in group 2 almost everyone responded that they felt on the right track.

Q2: What can I do differently?

The participants in the two groups said they could see them more slowly and more concentrated to understand them. Those in group 1 said they could see more illustrative examples.

"I can search to the internet for a video or more examples to help me understand." C.V. Group 1 participant

"I can take notes and find more examples." A.O. Group 1 participant

Q3: Who can I ask for help?

There were not significant differences between the two groups because everyone said that they would be asking for help either from a fellow student or the Internet or Mr. Samaras.

After:

Q1: What worked well?

At this question the way the content presented was shown to affect the answer, since the students in group 1 after reading the lecture did not feel that they understand full the content since the way they were presented did not help them. On the other hand, students in group 2 said that the way content presented help them to understand. the examples were helpful for both groups.

"I do not feel that I learned 100%" P.D. Group 1 participant

"The slides that I have had examples helped me, the rest were not very helpful" A. S. Group 1 participants

"The way the content was presented the shapes and the explanation helped me." E. K. Group 2 participants.

Q2: What could I have done better?

Students from both groups said they could take notes as they read and that they could see them again. The students in the group 1 also said they would like to see more examples.

"I could see them again more carefully and find examples from the internet" A. S. Group 1 participant.

"I could get notes as I read them and find more illustrative examples" S. K Group 1 Participant.

"To look at them again more concentrated" G. P. Group 2 Participant.

Q3: Can I apply this to other situation?

All participants, regardless of the group, responded positively.

Normalization Chapter

Before:

Q1: Is this similar to a previous task?

The answers were the same for both groups all remembered this chapter a little from the course EPL342.

Q2: What do I want to achieve?

And in this question the answers were the same for both groups since everyone wanted to read them to remember them.

Q3: What should I do first?

The most common answer for the both groups at this question was to read the content serially.

During:

Q1: Am on the right track?

In group 1 only 1 individual answered no, the others answered yes or probably. But, at the group only 1 individual answered yes, the others answered no.

Q2: What can I do differently?

The participants in the two groups said they could see them more slowly and more concentrated to understand them. Those in group 2 said they could see example and more organized.

“I can see them more concentrated and take notes on the paper.” K.T. Group 1 participant

“I can see more examples.” C.M. Group 2 participant

“I do not know what I would do otherwise I do not understand what I'm reading” E. K. Group 2 participant

Q3: Who can I ask for help?

There were not significant differences between the two groups because everyone said that they would be asking for help either from a fellow student or the Internet or Mr. Samaras.

After:

Q1: What worked well?

At this question the way the content presented was shown to affect the answer, since the students in group 1 after reading the lecture did not feel that they understand full the content since the way they were presented did not help them. On the other hand, students in the other group said that the way content presented help them to understand. The examples, the colors the shapes and the arrows were helpful for the group which saw infoVis.

"I feel I learned it and the way it was presented helped me." A.O. Group 1 participant

"Images and bows helped me understand the description as well" C. V. Group 1 participants

"Nothing worked well, I lost my interest during reading." G. P. Group 2 participants.

Q2: What could I have done better?

Students from both groups said they could take notes as they read and that they could see them again. The students in the group 2 also said they would like to see more examples.

"I could concentrate more and pass notes as I read" P. D. Group 1 participant.

"I could give more importance to what I read and look for more examples" G. P Group 2 Participant.

"I could make the shapes on the paper" M. P. Group 2 Participant.

Q3: Can I apply this to other situation?

All participants, regardless of the group, responded positively.

Chapter 6

Conclusion

6.1 Summarize of Thesis

The main objective of this thesis was to investigate whether there are difference at the time need to read and the score of the students they attended the lecture mode ant the students they attended the infographic mode. And if the different types of metacognitive skills or how motivated was the student affect the reading process. My thesis contains the description of the system we use to investigate if there are any relations between metacognition, motivation and visual presentation of a content.

The system includes for all user their profile, measurements about the time they need to read, the score they achieved to the quiz, the self-reporting motivation and the comments for the think aloud protocol. Also, they have some measurements from the eye-tracking like total fixations a read made during reading, the total fixations made in the area of interest and the duration of these fixations.

Using the quantitative measurements, we did a statistical analysis with these measurements, and using the think aloud protocol we did a qualitative analysis. Based on the above analysis we see that student which read Joins chapter using infographic achieved higher score at the quiz than the student they read Joins using lectures. We also see from the correlations that the students who read lectures for Joins make more fixations out of the area of interest and that shows that the lost their interest for what the read. For the Normalization chapter, we found that the way the content is represented influenced the time students need to study. The

student they read lectures needed more time to understand this chapter than the students they read infographic. Furthermore, we did an exploratory analysis to see if our results from the 2 questionnaires are consistent with the literature and eventually there were. Finally, from the qualitative analysis we concluded that the visual representation of the content is more helpful for the students. The way the information is represented, the colors, the bows helped the students to stay focus and understand which information are important to read.

6.2 Future Work

The system can be extended in future by adding other chapter of the course EPL342 Databases, or even other courses. We can make infographics for all the chapter of the Databases and ask the students to evaluate them. In future work, we could do the experiment with more than 20 participants to find more reliable results and maybe to find some others results. Also, we can take some other measurements for the cognition of the students and correlate them with metacognition and motivation and then we can see if they influence the learning process.

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Appendix A – Academic Motivation Scale

Does not correspond at all	Corresponds little	Corresponds moderately	Corresponds a lot	Corresponds exactly
1	2 3	4	5 6	7

WHY DO YOU GO TO COLLEGE?

1	2	3	4	5	6	7

1. Because with only a high-school degree I would not find a high-paying job later on.
2. Because I experience pleasure and satisfaction while learning new things.
3. Because I think that a college education will help me better prepare for the career I have chosen.
4. For the intense feelings I experience when I am communicating my own ideas to others.
5. Honestly, I don't know; I really feel that I am wasting my time in school.
6. For the pleasure I experience while surpassing myself in my studies.
7. To prove to myself that I am capable of completing my college degree.
8. In order to obtain a more prestigious job later on.
9. For the pleasure I experience when I discover new things never seen before.

10. Because eventually it will enable me to enter the job market in a field that I like.
11. For the pleasure that I experience when I read interesting authors.
12. I once had good reasons for going to college; however, now I wonder whether I should continue.
13. For the pleasure that I experience while I am surpassing myself in one of my personal accomplishments.
14. Because of the fact that when I succeed in college I feel important.
15. Because I want to have "the good life" later on.
16. For the pleasure that I experience in broadening my knowledge about subjects which appeal to me.
17. Because this will help me make a better choice regarding my career orientation.
18. For the pleasure that I experience when I feel completely absorbed by what certain authors have written.
19. I can't see why I go to college and frankly, I couldn't care less.
20. For the satisfaction I feel when I am in the process of accomplishing difficult academic activities.
21. To show myself that I am an intelligent person.

22. In order to have a better salary later on.

23. Because my studies allow me to continue to learn about many things that interest me.

24. Because I believe that a few additional years of education will improve my competence as a worker.

25. For the "high" feeling that I experience while reading about various interesting subjects.

26. I don't know; I can't understand what I am doing in school.

27. Because college allows me to experience a personal satisfaction in my quest for excellence in my studies.

28. Because I want to show myself that I can succeed in my studies.

Appendix B – Metacognitive Awareness Inventory

I never or almost never do this 1	I do this only occasionally 2	I sometimes do this (about 50% of the time) 3	I usually do this 4	I always or almost always do this 5

Think of yourself as a learner. Read each statement carefully.

	1	2	3	4	5
1. I ask myself periodically if I am meeting my goals.					
2. I consider several alternatives to a problem before I answer.					
3. I try to use strategies that have worked in the past.					
4. I pace myself while learning in order to have enough time.					
5. I understand my intellectual strengths and weaknesses.					
6. I think about what I really need to learn before I begin a task.					
7. I know how well I did once I finish a test.					
8. I set specific goals before I begin a task.					
9. I slow down when I encounter important information.					

10. I know what kind of information is most important to learn.

11. I ask myself if I have considered all options when solving a problem.

12. I am good at organizing information.

13. I consciously focus my attention on important information.

14. I have a specific purpose for each strategy I use.

15. I learn best when I know something about the topic.

16. I know what the teacher expects me to learn.

17. I am good at remembering information.

18. I use different learning strategies depending on the situation.

19. I ask myself if there was an easier way to do things after I finish a task.

20. I have control over how well I learn.

21. I periodically review to help me understand important relationships.

22. I ask myself questions about the material before I begin.

23. I think of several ways to solve a problem and choose the best one.

24. I summarize what I've learned after I finish.

25. I ask others for help when I don't understand something.

26. I can motivate myself to learn when I need to

27. I am aware of what strategies I use when I study.

28. I find myself analyzing the usefulness of strategies while I study.

29. I use my intellectual strengths to compensate for my weaknesses.

30. I focus on the meaning and significance of new information.

31. I create my own examples to make information more meaningful.

32. I am a good judge of how well I understand something.

33. I find myself using helpful learning strategies automatically.

34. I find myself pausing regularly to check my comprehension.

35. I know when each strategy I use will be most effective.

36. I ask myself how well I accomplish my goals once I'm finished.

37. I draw pictures or diagrams to help me understand while learning.

38. I ask myself if I have considered all options after I solve a problem.
39. I try to translate new information into my own words.
40. I change strategies when I fail to understand.
41. I use the organizational structure of the text to help me learn.
42. I read instructions carefully before I begin a task.
43. I ask myself if what I'm reading is related to what I already know.
44. I reevaluate my assumptions when I get confused.
45. I organize my time to best accomplish my goals.
46. I learn more when I am interested in the topic.
47. I try to break studying down into smaller steps.
48. I focus on overall meaning rather than specifics.
49. I ask myself questions about how well I am doing while I am learning something new.
50. I ask myself if I learned as much as I could have once I finish a task.
51. I stop and go back over new information that is not clear.
52. I stop and reread when I get confused.

Appendix C – Quiz about Joins

1. Which join condition does not contains an equality operator? (10)
   1. EQUI JOIN
   2. CARTESIAN PRODUCT
   3. NATURAL JOIN
   4. OUTER JOIN

2. Process in which tuple is created by having combined attributes from two relations is classified as (10)
   1. CARTESIAN PRODUCT
   2. NATURAL JOIN
   3. THETA JOIN
   4. JOIN

3. Suppose relation R(A,C) has the following tuples and relation S(B,C,D) has the following tuples: (20)

R

A	C
3	3
6	4
2	3
3	5
7	1

S

B	C	D
5	1	6
1	5	8
4	3	9

Compute the natural join of R and S. Which of the following tuples is in the result? Assume each tuple has schema (A,B,C,D)

1. (2, 4, 3, 9)
2. (3, 2, 1, 6)
3. (7, 1, 5, 8)
4. (5, 1, 6, 4)

4. Suppose relation R(A,B) has the following tuples and relation S(B,C,D) has the following tuples: (30)

R

A	B
1	a
7	t
2	g
4	c
9	t

S

B	C	D
c	5	6
a	7	8
t	8	9

Compute the theta-join of R and S with the condition R.B = S.B AND R.A < S.C Which of the following tuples is in the result? Assume each tuple has schema (A, R.B, S.B, C, D).

1. (1, a, c, 5, 6)
2. (9, t, t, 8, 9)
3. (2, g, c, 5, 6)
4. (1, a, a, 7, 8)

5. Which join refers to join records from the write table that have no matching key in the left table are include in the result set? (10)

1. Left outer join
2. Right outer join
3. Full outer join
4. Half outer join

6. JOIN operation in which two attributes joined have same name in both relations is classified as (10)

1. RIGHT OUTER JOIN
2. JOIN
3. CARTESIAN PRODUCT
4. NATURAL JOIN

7. If matching tuples are not found, kind of OUTER JOIN operation which keeps all tuples of first and second relation is classified as (10)

1. CARTESIAN PRODUCT
2. ANTI JOIN
3. LEFT OUTER JOIN
4. FULL OUTER JOIN

Appendix D – Quiz about Normalization

1. In the _____ normal form, a composite attribute is converted to individual attributes(10)

1. FIRST
2. SECOND
3. THIRD
4. FOURTH
5.

2. Tables in second normal form (2NF): (15)

1. Eliminate all hidden dependencies
2. Eliminate the possibility of a insertion anomalies
3. Have a composite key
4. Have all non key fields depend on the whole primary key

3. Which forms simplifies and ensures that there is minimal data aggregates and repetitive groups (15)

1. 1NF
2. 2NF
3. 3NF
4. All of the mentioned

4. Which forms are based on the concept of functional dependency (10)

1. 1NF
2. 2NF
3. 3NF
4. 4NF

5. Empdt1(empcode, name, street, city, state,pincode). For any pincode, there is only one city and state. Also, for given street, city and state, there is just one pincode. In normalization terms, empdt1 is a relation in (25)

1. 1NF only
2. 2NF and hence also in 1NF
3. 3NF and hence also in 2NF and 1NF
4. BCNF and hence also in 3NF, 2NF and 1NF

6. A relation is in this form if it is in BCNF and has no multivalued dependencies (10)

1. 2NF
2. 3NF
3. 4NF
4. 5NF

7. A relation in this form is free of all modification anomalies (15)

1. 1NF
2. 2NF
3. 3NF
4. BCNF