Measuring Educational Quality in Secondary Education

Master's Thesis

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Abstract

This research tries to assess the important factors in assuring education quality in secondary schools in the Netherlands by using a business intelligence approach. Business intelligence framework is translated by using business intelligence process to identify the stakeholders and components relevant to education quality. A framework for education quality is produced, which consists of seven Critical Success Factors (CSF) and measured through Key Performance Indicators (KPI). This framework is generated through expert interview and questionnaire survey. Then a feasibility analysis is conducted in the environment of an information system that is implemented for secondary schools in the Netherlands.

Keywords: Business intelligence, CSF, KPI, Education Quality

Acknowledgements

This thesis on Measuring Educational Quality in Secondary Education is the end result of my master study in Business Informatics at Utrecht University. This thesis would not be completed without the help of numerous people and organization throughout the process. I would like to take this opportunity to thank them for their assistance and support.

First of all, I would like to thank my supervisors from Utrecht University, Marco Spruit and Jan Martijn van der Werf, for giving me guidance, support, and feedback throughout the project. Secondly, I would like to thank Datapas BV for allowing me to perform this research in their company. My supervisors, Maarten Vissers and Teun Slijkerman, for providing me with discussion time, contacts, and supporting me to complete this master thesis.

I would also like to thank the experts that have provided me their time for discussion and constructive ideas, which really give me perspective towards my research. I would also like to thank my survey respondents who have spared their time to participate in the questionnaire, which truly supports my research.

My biggest gratitude is to God, who has bestowed me with health to accomplish this master thesis and finish my education. And finally, I would like to thank my loved ones for their support throughout this process. Having faith in me to complete this thesis and assure me to also believe in myself, to persevere, and pushing me in difficult times during the process. My parents and sister, who blessed me to move halfway around the world to pursue my education and always send me their love; friends and family back home; and most importantly close friends here in the Netherlands, whom I interact with daily and keep on supporting me throughout. Thank you, I couldn't make it without your love and support.

Utrecht,
December 2013

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Chapter 1 – Introduction

1.1. Research Trigger

In order to be competitive in the future, we ought to be concerned about the quality of education that is being provided (Madu & Kuei, 1993). As important as this is, assessing and evaluating the quality of education is not an easy task. Before we could say that the school has good educational quality, we should first know what a good quality means in education which would involve many stakeholders, where different stakeholders would have different perspectives on what quality is in education (Becket & Brookes, 2005; Scheerens, Luyten, & Ravens, 2011). The quality of education is likely to be defined differently from the point of view of ministry of education, school governors and managers, teachers, students, and the parents of students. If we want to find a core of criteria for assessing quality in education it is essential that we understand the different concepts of quality that inform the preferences of different stakeholders (Harvey & Green, 1993).

Even though many research works have been conducted in assessing quality in education, there is no standard on how to measure quality of education (Becket & Brookes, 2005). This is influenced by the difference in components that are involved in each research, such as stakeholders, components of education, concept of education, and most importantly the definition of quality itself. There are many different but interrelated concepts and definitions of education quality available and used by previous researches. Some view quality in education as the ability of being exceptional, other sees it as the ability of following a set of rules perfectly, and there also exist the view of education quality as empowerment to their participant through added value.

In the Netherlands there exists a protocol for measuring education quality in schools, which are conducted by Education Inspectorate by investigating various aspects that affect the education process. However, this inspection is conducted on a yearly basis as it relies on some data that are only available yearly. This means that the measurement of the school strategy can only be done on a yearly basis, which is not ideal for schools as they couldn't see whether their activities are conducted towards the right direction. Therefore the urgency of this research is to provide a so-called 'traffic light' which gives warning when school activities are not going to the desired goal. This could make possible by having an assessment model which measurements are conducted on a shorter period of time instead of just having an evaluation result at the end of a school year. By providing such measurement, schools could see how they are performing and make necessary decisions to achieve a good education quality. Furthermore, as previous researches focus more on quality in higher education, this research aims its focus on secondary education level in the Netherlands.

An approach that could be used in resolving this is by employing business intelligence to help schools in decision making. According to Ranjan (2009), business intelligence is applied for gathering, providing access to, and analyzing data to help enterprise make better business decisions. In measuring and achieving educational quality, this concept could be implemented to help school direct their policy. This research will use the different layers of business intelligence framework – explained further in the following chapters – which includes identification of critical success factors and key performance indicators.

1.2. Problem Statement, Objective, and Deliverable

From the previous sub-chapter, the problem statement could be summarized as "how to measure quality in secondary education, by taking into consideration all different aspects that affect the teaching and learning process and is available and measureable throughout the school year?" In order to resolve such problem statement, the general objective of this research is to identify the aspects that are important in assuring quality in secondary education by creating a framework that encompasses all the important components and stakeholders of the education process. This framework should be able to give a structured guideline and overview of the school situation, so that schools could measure their performance at any point in a school year; and capture different aspects from the education system, which aims on two different users. First, it gives school board members an overview of how their school in general is performing and helps in decision making process. Second, the people involved in day-to-day school activity (i.e. teachers) will be able to monitor how the students are advancing in their studies.

Furthermore, the research objective could be broken down and specified as follows:

- Identify significant stakeholders that needed to be included in measuring educational quality
- Derive critical success factors by interviewing significant stakeholders using a semi-structured method
- Determine available definitions for measuring educational quality which are then operationalized into key performance indicators constructed from several performance indicators
- Measure critical success factor with key performance indicator and define initial educational quality measurement
- Review and improve the initial quality measurement to get a well-developed and comprehensive quality measurement

1.3. Research Questions

In order to define a standard for measuring educational quality in secondary schools in the Netherlands, various aspects and different stakeholders should be taken into consideration. Business intelligence plays an important role here, as it could capture and facilitate all this to improve decision making. The research question addressed in this research is "how can business intelligence process be employed to assess the quality of education in secondary schools in the Netherlands?"

This main research question consists of four sub research questions that this research tries to answer, as follows:

i. What is the definition of quality in the context of education
ii. What stakeholders and components should be included in measuring quality in education
iii. What data are currently available and what are still needed to measure education quality
iv. To what extent can business intelligence be employed in assuring education quality

1.4. Relevance

The relevance of this research could be seen both scientifically and socially, as the implementation of Business Intelligence in the education sector could be considered relatively uncommon in practice. Even though there has been lack of implementation and integration in this area, business intelligence in the education sector is very interesting and important to be investigated.

1.4.1 Scientific

Scientifically, this research would be considered relevant as it employs business intelligence process in the educational sector. Even though business intelligence process is a familiar term used nowadays, not many researchers have implemented this concept specifically in the education sector. This is proven with the lack of literature found in this topic for the literature review. Most researches and publications available focus more on business intelligence from the technical approach, such as data mining. No previous research work has used all different layers in the business intelligence framework, namely vision, strategy, critical success factors, key performance indicators, and scorecards (Roekel, Linders, Raja, Reboullet, & Ommerborn, 2009) to create a model that could be used to measure education quality. Previous researches have come up with dimensions and indicators in measuring education and institution quality (Becket & Brookes, 2005; Owlia & Aspinwall, 1998; Borahan & Ziarati, 2002; Gibbs, 2010; Widrick, Mergen, & Grant, 2002), but none have used the concept of business intelligence. Furthermore, the previous research works mainly focused in higher education (university level). This research will be focused on the secondary education level, where the critical success factors will be

identified from experts, which are then measured against corresponding key performance indicators to identify important aspects that should be included in the model to measure education quality in the secondary education.

What have been found in practice currently is that business intelligence is mainly used commercially in the business industry. This research aims to show that business intelligence process could be employed for decision making not only at a corporate level, but also in the education sector. As well as board members of a company, school councils must make decisions regarding how and in which direction they want to guide their underlying schools. Business intelligence would play an important role here because various factors should be taken into consideration in this decision making process. The data involved in this process varies in terms of form, structure, and source.

1.4.2 Social

From the societal aspect, it could be stated that this research is important in assuring the quality of education in secondary schools in the Netherlands. By performing this research, creating a measurement for secondary education level would be made possible. This measurement could be used to monitor how a certain school is currently performing, and by doing so it is possible to assure that every school would perform their teaching and learning process to achieve a certain goal. Monitoring would be made more convenient by creating a dashboard that will give an overview and allow quick look of school performance. In the long run, it is hoped that this specified measurement could be used as a parameter for benchmarking in secondary schools in the Netherlands.

In the current practice, a standard to measure day to day activity is currently unavailable, as the available measurement is only for a yearly basis evaluation. By performing this research, it is expected that a parameter would be made available. Such a parameter could be used by secondary schools as a measurement on how they are currently performing by comparing with a certain standard.

Furthermore, schools could evaluate whether they are moving towards the desired directions in the daily teaching and learning activity, as this measurement will give them directions on how the school is performing. Furthermore, it is hoped that the result of this research could be used as a starting point for further research in this topic, and could be further developed not only for secondary schools.

Chapter 2 – Research Approach

This chapter explains the methodology and model employed in conducting this research. In Chapter 2.1. the research model is elaborated, along with how it relates with this research. Next, Chapter 2.2. explains different methodology that are used in this research.

2.1. Research Model: Design Science

In their work, Hevner, March, Park, & Ram (2004) argues that there are two paradigms in acquiring knowledge required to successfully develop, implement, and communicate an information system, namely behavioral-science and design-science paradigm. Behavioral-science is related to natural science research method, in a way that it tries to find an explanation and prediction of the organization and human phenomena surrounding information systems. On the other hand, design-science which is originally derived from engineering, is a research paradigm which involves the design and creation of innovative artifacts to answer questions relevant to human problems (Hevner & Chatterjee, 2010) and analyzing the "use and/or performance of such artifacts to improve and understand the behavior of aspects of Information Systems" (Vaishnavi & Kuechler, 2004). The latter approach or paradigm is viewed suitable to be implemented in this research as it will create an artifact which is the framework for education quality measurement in secondary school.

In order to conduct, evaluate, and present design science research properly, this research follows the seven guidelines provided by Hevner et al. (2004). The seven guidelines and how this research relates to them are explained below:

1. Design as an Artifact
   "Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation" (Hevner et al., 2004, p.83). The framework created as a deliverable of this research is an artifact for addressing the problem, which is to measure the quality of education. Hence, the first guideline will be fulfilled by this research. The artifact can be further developed so that it could be implemented to other education sectors as well, and not only on secondary schools.

2. Problem Relevance
   "The objective of design-science research is to develop technology-based solutions to important and relevant business problems" (Hevner et al., 2004, p.83). This research could relate to the second guideline as it will identify business intelligence framework layers and implement business intelligence process model in responding to the research trigger.

3. Design Evaluation
   "The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods" (Hevner et al., 2004, p.83). The framework generated in this research will be evaluated in an information system environment through feasibility analysis. By conducting this step, this guideline is fulfilled.

4. Research Contributions
   "Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies" (Hevner et al., 2004, p.83). The contribution provided by and relevance of this research were discussed in chapter 1.4.

5. Research Rigor
   "Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact" (Hevner et al., 2004, p.83). This research relies upon rigorous aspects in the academic field, and provides elaboration on the motivation and processes undertaken in designing, developing, and evaluating the framework, which fulfills this guideline.

6. Design as a Search Process
   "The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment" (Hevner et al., 2004, p.83). This guideline is addressed through literature review, expert interviews, and survey.

7. Communication of Research
   "Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences" (Hevner et al., 2004, p.83). Detailed explanation of the research background, process, and implementation plan will be made available and well-documented and presented so that it is easily understood by the readers. This research fulfills this guideline by providing those.

Hevner et al. (2004) in their paper also presented a conceptual framework for information system research that learns the environment and knowledge base for conducting and supporting the research. The implementation of this framework for this research is shown in Figure1, where the relevant research activities are depicted in the blue boxes and other relevant component is presented as well. Important stakeholders and components of education process are identified through an initial interview with experts in the field of education. Literature study is performed to understand the theoretical concepts of education quality and business intelligence. Results from these activities are used to create a framework which will be validated through

questionnaire and feedbacks from practitioners in the education field. The received feedbacks are also used for framework improvement.

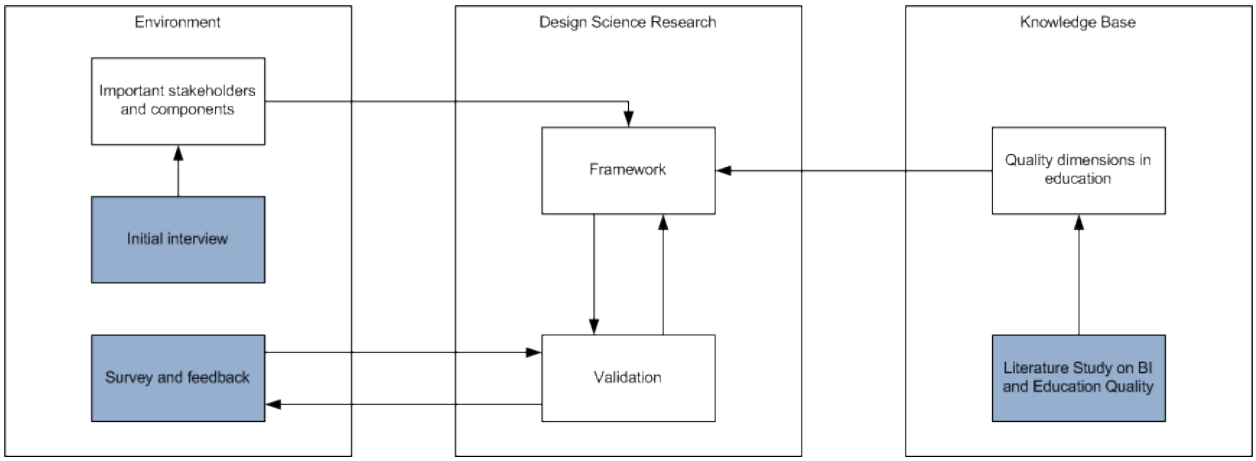

Figure 1 - Research Framework

2.2. Research Activities

2.2.1 Literature Study

A literature study is conducted in both the topic of education quality and business intelligence. According to Denney and Tewksbury (2012), literature study is important as it forces the researcher to educate him/herself as much as possible about the topic which assists in the learning process and discovering what have and have not been studied in that area. Furthermore, they argue that the researcher could identify weaknesses and shortcomings of prior literature.

Following the structured approach proposed by Webster and Watson (2002), the first step that should be conducted is to start the search within leading journals. Google scholar search engine is used for this purpose, along with Utrecht University Library's Omega. For each search result, the first step taken is title analysis followed by abstract analysis. If the abstract analysis shows that the literature is suitable for this research, it is then further learned and analyzed.

For each relevant literature, the next step conducted is performing ancestry approach where information is retrieved by "tracking" citations from one study to another (Cooper, 1982). Ancestry approach, or also known as footnote chasing, is "the adroit use of other authors' references to the prior literature on a topic" (Cooper & Hedges, 1994) which is a very effective method in literature study as it scopes the literature to usable primary studies almost immediately.

2.2.2 Semi-Structured Interview

In this research, a semi-structured interview method is employed to gather data from experts in the field of education. A semi-structured interview is verbal interchange where "the interviewer

attempts to elicit information from another person (interviewee) by asking questions" (Longhurst, 2010). Generally semi-structured interviews are organized around a set of open-ended questions, with other questions emerging from the dialogue between interviewer and interviewee/s which offers participants the chance to explore issues they feel are important (Longhurst, 2010; DiCicco & Crabtree, 2006).

The interviewees involved in this research include policy advisors of a school group, quality assurance personnel of a school group, independent researchers on education management and quality, and founder of an education quality assessment organization. A semi-structured interview is found to be suitable in this case as the interviewer is also able to gather data on the more intangible aspects of the school's culture, e.g. values, assumptions, beliefs, wishes, problems (Cohen, Manion, & Morrison, 2007), to give a background for this research.

2.2.3 Questionnaire

Survey through questionnaire is conducted as part of this research for the validation purpose. This method is found to be most suitable as it allows estimate response of the population by making inference from the information gathered from sample individuals (Groves, 2011; Kelley, Clark, Brown, & Sitzia, 2003). Survey itself could be defined as 'the selection of a relatively large sample of people from a pre-determined population, followed by the collection of a relatively small amount of data from those individuals', as described by Kelley et al. (2003).

Questionnaire is an objective means of collecting information, is relatively easy to administer, and 'are not susceptible to interviewer bias or variability' (Sivo, Saunders, Chang, & Jiang, 2006). Due to the structured and predefined nature of questionnaire, it is useful to gather information about people's knowledge, beliefs, attitude, and behavior; regarding themselves or some other unit of analysis such as their work group, project, or organization (Boynton & Greenhalgh, 2004; Sivo et al., 2006).

The questionnaires handed out in this research are online and aimed for school directors of the different level of secondary schools in the Netherlands. Directors are chosen as respondents because they are on the top level management of school and could provide an overview of teaching and learning activity.

Chapter 3 – Theoretical Background

This chapter elaborates on the literature study result which is used as the background of this research. In Chapter 3.1. the education system in the Netherlands is explained, with the emphasis on the structure of the secondary school, followed by Dutch school organization (e.g., authorities) in Chapter 3.2. Next, theoretical background on education quality is explained in Chapter 3.3.

3.1. Dutch Education System

In the Netherlands, the education system is divided into three parts: primary, secondary, and tertiary education, as shown in Figure 2 (Scheerens et al., 2011; Dutch Eurydice Unit, 2007). Most children in the Netherlands start their education at the age of four, although they are not required by law to attend school before reaching the age of five. Primary education lasts for the duration of eight years, until they reach the age of about 12.

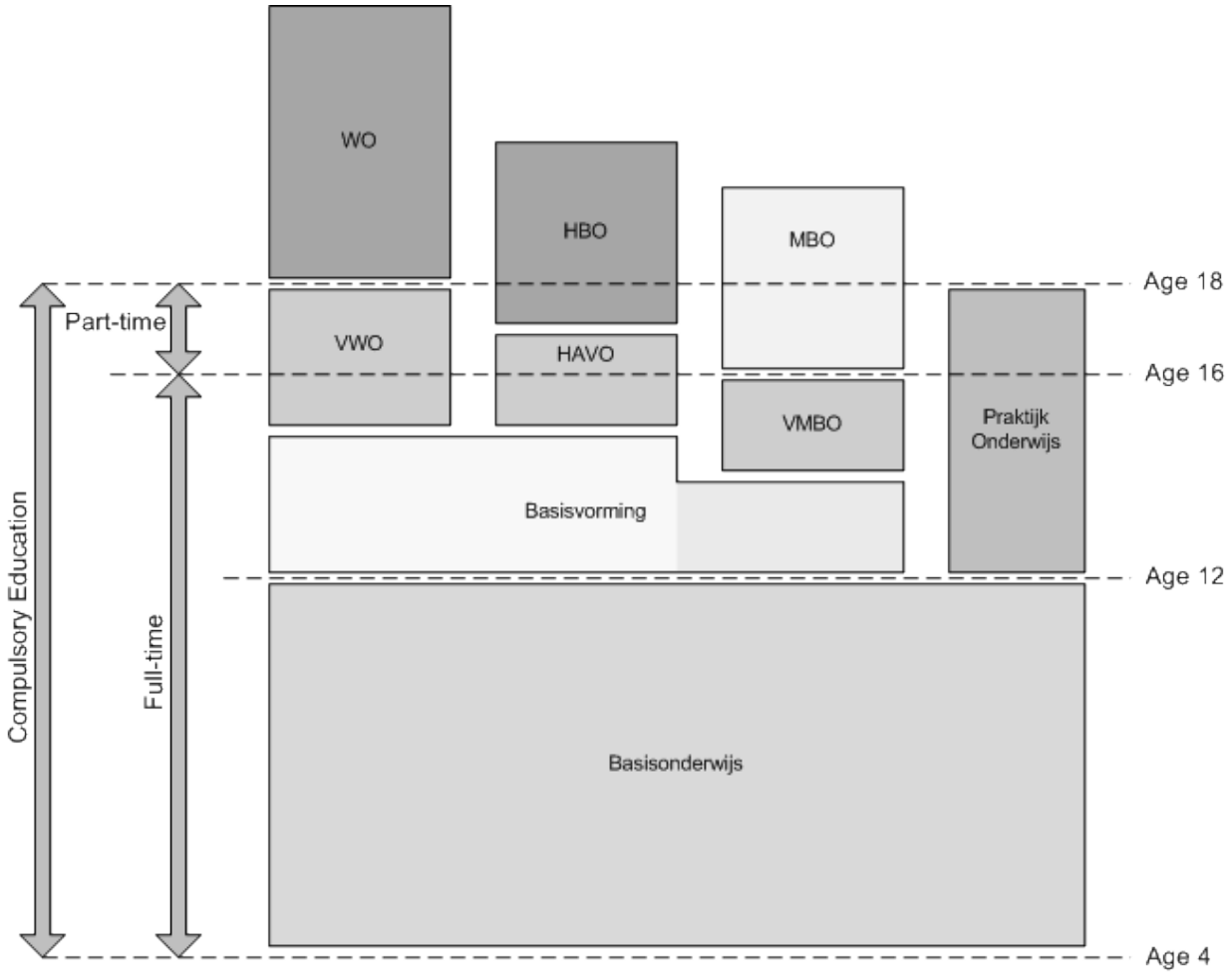

Figure 2 - Education System in the Netherlands

After finishing primary education, students will enter one of the three types of secondary education, namely VMBO (pre-vocational secondary education), HAVO (senior general secondary education), and VWO (pre-university education). Pupils move after primary education to one of the type of schools described above on the basis of their achievement levels within primary education (Scheerens et al., 2011). The smartest students go to VWO and HAVO, while the rest goes to VMBO schools. The first year of all levels is referred to as the *brugklas* (bridge class), as it connects the primary education system to the secondary education system.

In the Dutch education system, the first phase that students undertake in the secondary school is known as *basisvorming* which literally means basic education. It is the first two years of the VMBO education, while for HAVO and VWO students it is the first three years of their secondary education. During this stage in the education process, emphasis is on acquiring and applying knowledge and skills, and delivering an integrated curriculum (Dutch Eurydice Unit, 2007) by providing students with the same education as the base for continuing their education, from VMBO level to VWO. At this stage pupils follow the same subjects, which are languages, mathematics, history, arts, and sciences. After completing this stage, students enter the upper secondary education or *tweede fase* in Dutch.

3.1.1 VMBO

The term VMBO stands for *Voorbereidend Middelbaar Beroepsonderwijs*, or pre-vocational secondary education, combines vocational training with theoretical education in languages, mathematics, history, arts and sciences. VMBO lasts for four years and has four different levels, based on the combination portion of practical vocational training and theoretical education (School Choice International, 2008) which students should choose at the end of the second year for the continuation after *basisvorming*. The different levels are:

1. *Theoretische Leerweg* (VMBO-t), or theoretical learning path, is the most theoretical program of the pre-vocational education.
2. *Kaderberoepsgerichte Leerweg* (VMBO-k), or middle management-oriented learning path, is a middle-management program which teaches theory and vocational education equally.
3. *Gemengde Leerweg* (VMBO-g), or combined learning path, is a mixed program which focus is between the theoretical and the middle management-oriented paths. In practice, the existence of this learning path is very small as not many schools with this path exist.
4. *Basisberoepsgerichte Leerweg* (VMBO-b), or basic profession-oriented learning path, equips and prepares student for vocational training in the higher level of education.

Aside from the learning paths, VMBO is also divided into four sectors which students should choose after *basisvorming*. These different sectors are Economics, Engineering, Health and Social Services, and Agriculture.

3.1.2 HAVO

HAVO or *Hoger Algemeen Voortgezet Onderwijs* which literally means senior general secondary education is the secondary education which is intended to prepare students for professional higher education. This type of secondary education has duration of five years. After finishing education in HAVO, students could continue to professional higher education (HBO) or also known as polytechnic level. At the end of the *basisvorming* which is the end of their third year, students must choose one of the four profiles which will be explained in the next part.

3.1.3 VWO

VWO stands for *Voorbereidend Wetenschappelijk Onderwijs*, which means pre-university secondary education, is the secondary educational system which prepares the students for academic higher education (WO) or generally known as university level. This education lasts for six years and is attended by students from the age of 12-18. There are three different types of VWO available, namely *Atheneum*, *Gymnasium*, and TVWO. TVWO stands for *Tweetalig* VWO, where lectures are given in two languages: Dutch and a different language. Similar with HAVO, at their fourth year of study VWO student must choose one of the four profiles for their second phase.

3.1.4 The Second Phase (*Tweede Fase*)

After completing the *basisvorming* in their first three years of school, HAVO and VWO students should choose one of the four profiles which they find most suitable. The four profiles that they could choose from are as follows:

1. C&M (*Cultuur en Maatschappij*) or culture and society emphasizes on arts and foreign languages. The mathematics classes focus on statistics and stochastic.
2. E&M (*Economie en Maatschappij*) or economics and society emphasizes on social sciences, economy, and history. The mathematics classes focus on statistics and stochastics.
3. N&G (*Natuur en Gezondheid*) or science and health emphasizes on biology and natural sciences. The mathematic classes focus on algebra and geometry.
4. N&T (*Natuur en Techniek*) or science and technology emphasizes on the natural sciences. The mathematics classes focus on algebra and geometry.

3.2. Dutch School Organization

Dutch educational system combines a central educational policy with the decentralized administration and management of the institutions. All schools are governed by a legally recognized and competent authority or school board, which is the body that is responsible for implementing legislation and regulations in schools. Ministry of Education, Culture, and Science (Dutch: *Ministerie van Onderwijs, Cultuur, en Wetenschap*; MinOCW) on behalf of the central government controls education through legislation, with their main responsibility is to structure

and finance the system, the Education Inspectorate (Dutch: *Onderwijs Inspectie*), the central examination, and student support. Central government is becoming more and more responsible only for more general or framework legislation and for ensuring and monitoring the quality of education, while much of the authority they formerly hold has now been transferred to school boards.

The freedom of education as stated in article 23 of the Dutch Constitution assures the freedom to found schools and provide education in this school based on a specific principle or religion (Bal & Jong, 2007) which is the foundation of private schools in the Netherlands, as opposed to the general principle of public schools. Private and public schools have several differentiations in characteristics (Hofman, Hofman, & Guldemond, 2002; Bal & Jong, 2007; Hofman, Hofman, & Gray, 2008), which are summarized in Table 1. Both private and public schools are equally financed by government, which makes it possible for primary and secondary education in the Netherlands to be free of charge. This supports the Compulsory Education Act of 30 May 1968 that states every child has to go to school from the age of 5 until 16 and partial education obligation (attending school at least one day a week) until the age of 18; which later on revised and since September 2007 young people under the age of 18 are required to attend school until they attain a basic qualification (UNESCO IBE, 2012).

Table 1 - Characteristic Difference of Public and Private Schools

Private Schools	Public School
- Provide education based on religious and ideological beliefs and include: Roman Catholic, Protestant, Jewish, Muslim, Hindustani, and anthroposophy schools - Are allowed to refuse pupils whose parents do not subscribe to the belief or ideology of the school - Are not founded by the government, but funded by the government - Are governed by local autonomous school boards (a foundation or association) that consist of lay persons, very often parents with children attending the school they govern.	- Are open to all children, regardless their religious belief or ideology outlook - Are usually subject to public law - Are mainly managed by board members drawn from and paid by local district authorities (or a legal entity appointed by the local council), where the employees do not necessarily have children in the schools they govern

Most schools in the Netherlands are incorporated in a school group (school board) which consists of several schools. Some school group has members within one city or area, whilst other has school members spread around several provinces. The members of the central board of directors are mainly concerned with matters at strategic level (policy development and long term planning). Such subjects can relate to education and personnel and also to financial and material management. The increase in scale in secondary education as consequence of de-regulation and numerous educational innovations have led to many schools being merged (Bal & Jong, 2007).

3.3. Education Quality

Many research works have been done in the topic of educational quality, both in defining what quality in education means and in the effort for measuring the quality in education sector. The most fundamental work in defining the educational quality might be of Harvey and Green (1993), as many subsequent researchers base their work this. Even though their definition and differentiation of education quality focused on higher education, it can still be implemented in this research as they give a general categorization of education quality definition. They propose that the many different concepts of quality can be grouped into five discrete but interrelated ways of thinking, as follows:

1. Quality as exceptional
   The term exceptional means that quality is something special, which has three variations. The first one is the traditional notion of quality as distinctive, where quality is apodictic and there is no benchmark to measure quality. This is useless in term of assessing quality in education, because it doesn't provide definable measure. Secondly, quality is viewed as embodied in excellence which is exceeding very high standards that are almost unattainable. The final view of quality as exceptional dilutes the notion of excellence, as quality product is defined as one that has passed a set of quality checks based on attainable criteria that are designed to reject 'defective' items. In this view it could be said that quality is the result of scientific quality control, and quality is improved if standards are raised.
2. Quality as perfection or consistency
   This concept of quality focuses on process and sets specification that it aims to meet perfectly. The term 'zero defects' is used in this concept, and defines quality by the ability to conform to a particular specification perfectly and consistently. Furthermore, this view accentuates on prevention rather than inspection and always tries to ensure that things are done right the first time. It is by promoting a quality culture that zero defects could be achieved, where everybody in the organization is responsible for quality, and not just the quality controllers.
3. Quality as fitness for purpose
   In this concept, quality is judged in terms of the extent to which the product or service fits its purpose. However, this view raises many questions such as the relativity of whose purpose should be fulfilled, and how is fitness itself assessed. This view is differentiated into two sub-concepts, which are fitness for purpose based on customer specification and fitness for purpose based on mission or target. The customer itself is not clear in the education sector, whether it is the service user (i.e. student), or those who pay for the service (e.g. government, employers, parents), or should other stakeholders (e.g. academic staff) be included as the customer.

4. Quality as value for money
   When quality is related to value for money, the main consideration is effectiveness. There are two ways to measure quality in terms of value for money, performance indicators which provide a measure of accountability for the treasury, and customer charters which encapsulates accountability to the customers.

5. Quality as transformative
   The transformative view of quality is rooted in the notion of ‘qualitative change’, a fundamental change of form. Education is not a service for a customer but an ongoing process of transformation of the participant, be it student or researcher. This leads to two notions of transformative quality in education, enhancing the participant and empowering the participant. Enhancing the participant values the quality of education as the one that effects changes on the participants through added-value and, thereby, presumably enhances them. Empowerment of participants involves giving power to participants to influence their own transformation, which means the ability for them to make decisions.

Chapter 4 – Business Intelligence

This chapter provides information about business intelligence based on literature study. This chapter starts with the definition of business intelligence in 4.1., followed by business intelligence framework and its components in 4.2. Next in Chapter 4.3., different process models are explained (i.e., Six-Sigma and business intelligence process model), and a selection of the suitable process model for this research is placed. Chapter 4.4. explains the business intelligence architecture, while Chapter 4.5. gives an overview how the previously explained parts relate in this research.

4.1. Business Intelligence Definition

Many different definitions of business intelligence exist in the market depending on the background of the source, whether they are IT-related, data related, or business related (Roekel et al., 2009). Some literature refers to business intelligence as a (information) system while others define it as a process. The term business intelligence itself was first introduced by Howard Dresner in 1989, who was then a research fellow in Gartner Group. He used the term business intelligence as an umbrella term to describe a set of concepts and methods to improve business decision making by using fact-based support systems (Negash & Gray, 2008; Power, 2007). Even though different definitions are available and used, they all refer to this concept in general.

One of the most general definition of business intelligence is the one provided by Golfarelli, Rizzi, and Cella (2004) that defines business intelligence as the process of turning data into information and then into knowledge. Aligned with this definition is the one proposed by Ranjan (2008) which considers business intelligence as "the conscious, methodical transformation of data from any and all data sources into new forms to provide information that is business-driven and results-oriented" by utilizing mixture of tools, databases and vendors. While in their paper, Lönnqvist and Pirttimäki (2006) argue that business intelligence can be used to refer two definitions: (a) the information and knowledge relevant to describe an organization and its business, and (b) the process of soliciting information relevant for an organization's business activities and decision making. Ranjan (2009) argues that business intelligence is applied for gathering, providing access to, and analyzing data to help enterprise makes better business decisions.

On a different view of defining business intelligence, other literatures such as the work of Negash and Gray, 2003; Gangadharan & Swami, 2004; Watson and Wixom, 2007; and Roekel et al., 2009; give definitions from a system perspective. They stated that business intelligence is a system that combines data gathering, data storage, and knowledge management with analytical tools. Business intelligence system allows the analysis of large volume of structured and

unstructured detailed business data to evaluate complex corporate and competitive information, which are presented to planners and decision makers of the organization. Therefore, in general the feature of a business intelligence system should support reporting, analyzing, and modeling of the business aligned with its goal and objectives. Furthermore, a business intelligence system must have the ability to provide actionable information and knowledge at the right time, in the right location, and in the right form.

From these definitions there are differences in defining business intelligence based on the point of view. In general it could be grouped into two broad patterns, the managerial and technical view points (Ghazanfari, Rouhani, Jafari, and Akhavan; 2011). From the managerial approach, business intelligence is viewed as a process in which data gathered from inside and outside the enterprise are integrated in order to generate information relevant to the decision-making process. While the technical approach considers business intelligence as a set of tools that support the process in the managerial approach, with the focus is more on the technologies, algorithms, and tools, instead of on the process.

From the various definitions and different views there is one underlying concept, which is the purpose of business intelligence is to facilitate management level with information that supports better decision-making. Business intelligence controls, manages, and delivers abundant business information – around and within an organization – about an organization and its business process.

Further, Ghazanfari et al. (2011) added a third approach to business intelligence definition, namely system enabler approach. This third approach focuses on value-added capabilities in supporting shared information (Rouhani, Asgari, Mirhosseini; 2012).

As for the purpose of this research, the managerial view of business intelligence is followed. And business intelligence is defined as the process and methodology used to improve the timeliness and quality of inputs to the decision process by first identifying and then processing information into condensed and useful managerial knowledge and intelligence. (Roekel et al., 2009; Lönnqvist & Pirttimäki, 2006; Negash, 2004).

4.2. Business Intelligence Framework

Roekel et al. (2009) proposed a business intelligence framework which consists of several layers as shown in Figure 3. These layers are important in implementing business intelligence as it connects the vision of an organization with measurable data in the form of scorecards and dashboard. Every layer is connected to each other in a way that could be summarized as follows:

- Mission and vision statements lead to business goals and strategy. Critical Success Factors (CSFs) define the prerequisite to reach the goals, while strategy states how the goals should be reached.

- Business goals and imposed strategy lead to objectives and a policy (business plan). Key Performance Indicators (KPIs) define how the objectives will be measured, and the imposed policy will be stated with business rules.
- KPIs will be presented by scorecards, dashboards, etc. Business rules may be enforced by logic in the operational systems but may also be applied within the business intelligence environment.

Figure 3 - Business Intelligence Framework

4.2.1 Framework Components

Vision. Vision is the projection of an ideal that an organization wants to achieve, which represents or reflects the shared values and the right course of action that the organization should aspire (Van den Steen, 2005; Baum, Locke, & Kirkpatrick, 1998). Visions portray future possibilities and oftentimes convince people to let go of the past with the usage of inspiring statements and content. Visions also clarify a set of ideals, articulate a sense of purpose, and highlight the uniqueness of an organization (Berson, Shamir, Avolio, & Popper, 2001).

Strategy. Shubik (1959) explains that the everyday usage of the word 'strategy' implies some sort of over-all plan which an army commander, a football team, or a corporation might employ in carrying out a program (as cited in Ackoff, 1990, p. 522). In an organizational context, strategies could be defined as the basic approaches a management selects for designing the actions to solve a problem or accomplish goal, which are concerned with long-term objectives and ways of pursuing them that affect the system (or organization) as a whole. Therefore, organizational strategies are the decisions made by the highest level of management. Furthermore, strategic decisions set relatively long-range objectives for the organization as a whole, and formulate principles and policies to govern means used to pursue those objectives (Ackoff, 1990).

Critical Success Factors. This concept was first coined by Rockart (1979) in his paper (Martin, 1982; Boynton & Zmud, 1984; Slevin, Stieman, & Boone, 1991; Magal, Carr, & Watson, 1988) as:

> the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where "things must go right" for the business to flourish. If results in these areas are not quite adequate, the organization's efforts for the period will be less than desired. (p.85)

In their paper, Boynton & Zmud (1984) explained the solicitation process of CSFs as follows:

> CSFs emerge from structured dialogues between a skilled CSF analyst and the key personnel of a firm. A series of dialogue between the analyst and a manager should result in an explicit statement disclosing that individual's personal CSFs. CSFs should be elicited from managers who represents a cross section of the organization's major functional areas. This will provide a collection of consistently referenced CSFs which can be extracted and refined into a set of organizational CSFs. (p.17)

Based on the previous definitions, critical success factors could be defined as the most important aspects that an organization should focus on in order to reach its goal – which is the definition of CSF used in this research.

Key Performance Indicators. Parmenter (2007) in his book explains the concept and characteristics of key performance indicators (KPI). KPIs represent a set of measure focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization. He further explains that a good KPI will affect most of the core CSFs.

Scorecards/Dashboards. Dashboards and scorecards display important information that is arranged and consolidated in a single screen so that information could be digested at a single glance (Turban, Sharda, Delen, & King, 2010). Even though the term scorecard and dashboard are often used interchangeably, Turban et al. (2010) argues that they differ in the level of information displayed. Scorecard is used to monitor strategic alignment and success with strategic objectives and targets. Therefore it is used mostly in the managerial level. Meanwhile dashboard is mostly used in tactical and operational level as it presents information that is more practical and day-to-day in nature.

4.3. Process Models

4.3.1 DFSS

Design for Six Sigma (DFSS) is a systematic methodology that takes into account the application of different methods and tools of quality improvement in creating new products or process

design (Pavletic & Sokovic, 2009; Sokovic, Pavletic, & Pipan, 2010). This concept was coined by Motorola who first applied it to the design and production of its pagers in the late 1980s. This concept is widely used in the industry sector, and is found to be suitable to be implemented in this research in creating a new process model – which is the framework – for the ongoing process of education.

In putting DFSS into practice, there are many process steps known. But the most frequently reported methodology is known as DMADV (Basu, 2009). DMADV is the abbreviation of the steps undertaken, namely Define, Measure, Analyze, Design, and Verify. Each step is explained as follows:

1. **Define** is the initial step in the whole process. In this step, it is very important to define the purpose, scope, objectives, and expectations of the project, which could be seen as the final goal of the project.
2. In **Measure**, the current situation is identified.
3. **Analyze** is important to identify the possible solutions to achieve the identified goal, given the current situation.
4. The **Design** phase uses the process capability information and simulation to develop and optimize detailed design elements.
5. In the last step **Verify**, testing and validation of the design is conducted.

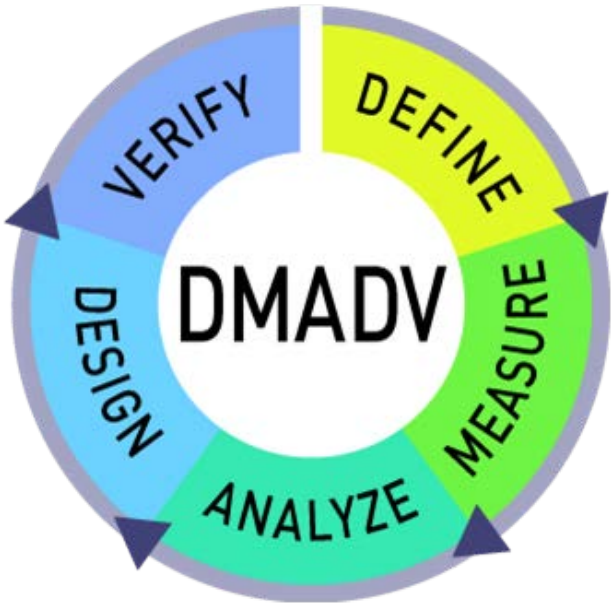

Figure 4 - DMADV Process Steps

DMADV is a cyclical model, as shown in Figure 4; therefore continuous improvement is made possible.

4.3.2 Business Intelligence Process Models

The objective of a business intelligence process is to refine business data and information into useful and valuable knowledge and intelligence for decision making (Pirttimäki, 2007; Sangar & Iahad, 2013). Many researches proposed different process steps and models in implementing business intelligence. One of the earliest business intelligence process steps introduced was by Gilad & Gilad (1985) who proposed a 5 steps process used to "reduce the flood of data about the external environment into a manageable amount of reliable and useful information for decision making". These five steps represent the key tasks in business intelligence, which is considered as a cornerstone in business intelligence process (see Figure 5). The first step is to "develop intelligence targets and priorities", where goals, targets, and priorities are defined in order to identify what information is relevant to those goals and will help direct the choice of sources. The next step in the process is to "establish a collection network", where the idea is to decentralized collection of information in order to accomplish wide coverage of sources effectively. The purpose of the third step is to evaluate the usefulness of the gathered data in the previous step by "developing data evaluation procedures". Next, the information gathered should be stored in a storage system which allows users to search through vast amount of information in a short time, and retrieve all related information available in a certain topic. The final step is to "determine dissemination procedures" so that the processed information could be communicated to decision-maker.

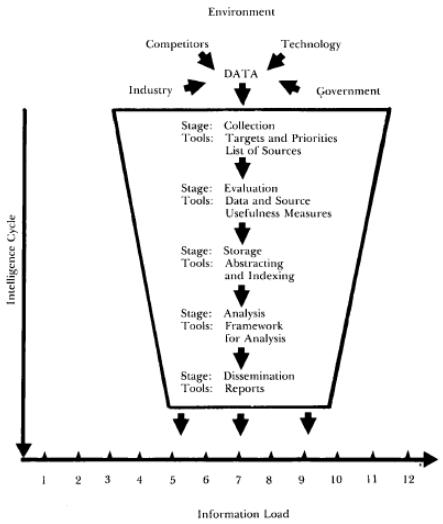

Figure 5 - BI Process, Gilad & Gilad (1985)

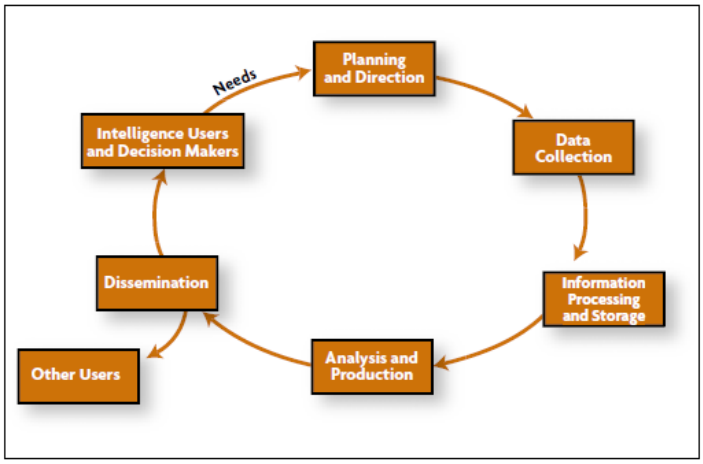

Figure 6 - BI Process, Thomas (2001)

Another notable work that is considered a pioneer in business intelligence process is the key intelligence topic by Herring (1999) which aims on identifying the organization's intelligence needs and determine the resource required to achieve them. His work is based on the intelligence cycle which is also the base of the business intelligence cycle introduced by Thomas (2001) as shown in Figure 6. The cyclical model starts with planning based on corporate needs, then ethically collecting reliable information from valid sources, then analyzing the data to form

intelligence in conjunction with strategic planning and market research. Finally, if the intelligence is to have value, it must be disseminated in a form that's clear and understandable.

The cyclical model by Thomas (2001) has similar steps as what is introduced by Gilad & Gilad (1985). Literature analysis shows that the theoretical process models proposed by academics and consultants in business intelligence field (e.g., Gilad & Gilad, 1985; Thomas Jr., 2001; Herring, 1999) are quite similar to each other (Pirttimäki, 2007; Sangar & Iahad, 2013). In general, the business intelligence process model could be summarized in the cyclical model proposed by Pirttimäki (2007) or Salonen & Pirttimäki (as cited in Sangar & Iahad, 2013, p. 177) as shown in Figures 7 and 8 respectively.

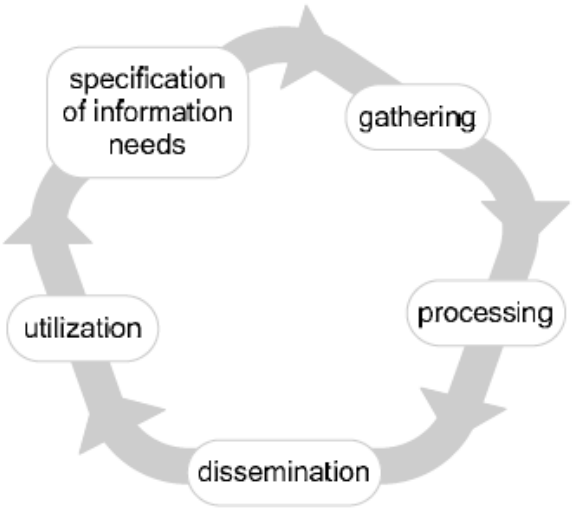

Figure 7 - General BI Process, Pirttimäki (2007)

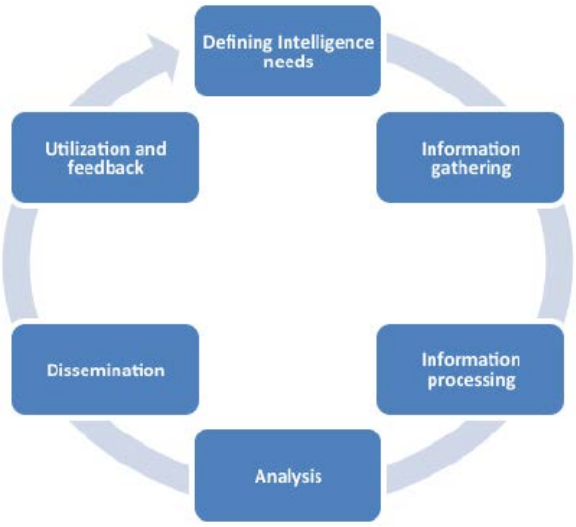

Figure 8 - General BI Process, Salonen & Pirttimäki

4.4. Business Intelligence Architecture

In their book, Turban et al. (2010) introduced a high-level architecture of business intelligence as depicted in Figure 9. They explain that a business intelligence system has four major components, namely a data warehouse, business analytics, business performance management, and user interface. The data warehouse environment has its own data source, which is "the cornerstone of any medium-to-large BI system" and is managed by the technical staff. The business analytics environment allows business users to work and manipulate the data and information in a data warehouse using variety of tools and techniques. Performance and strategy environment which includes business performance management allows a top-down enforcement of corporate-wide strategy, so that the BI system includes forecasting and planning based on specific organization need. The fourth component, user interface, is represented by an information broadcasting tool such as a dashboard, corporate portal, digital cockpits, and other

visualization tools. It presents at-a-glance view of the organization's health, as information from multiple areas is integrated here.

This high-level architecture of business intelligence is used as a blueprint in arranging the business intelligence framework explained in chapter 4.2. This research tries to address each components of business intelligence architecture (or part of it) through different research activities.

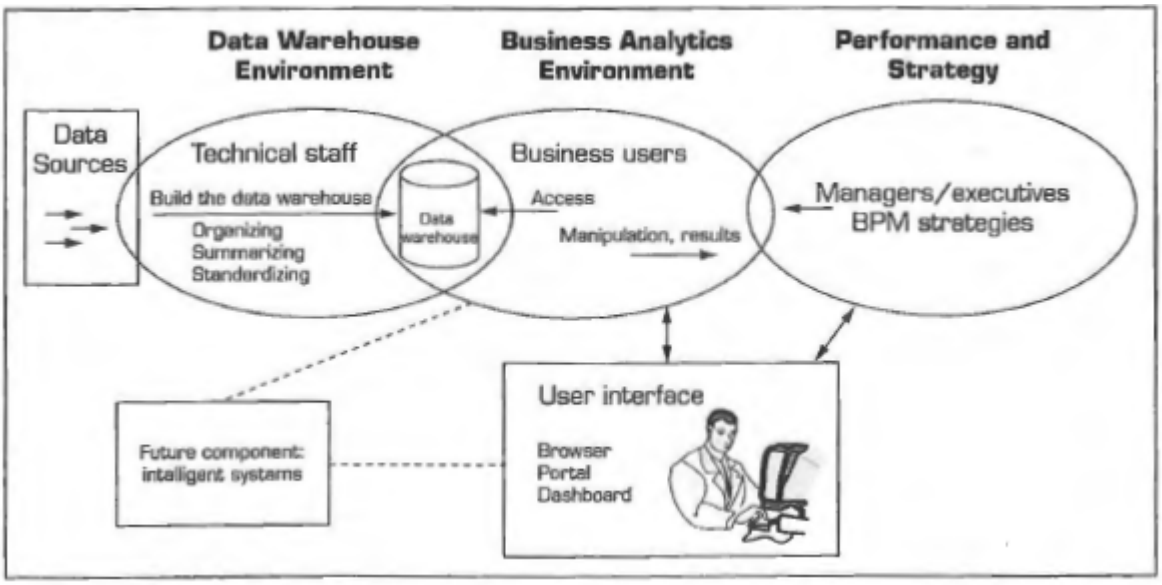

Figure 9 - High-Level Architecture of BI, Turban et al. (2010)

4.5. Implementation in Research

This research follows the six step business intelligence process model by Salonen & Pirttimäki as explained in Chapter 4.3.2. (Figure 8), in putting into practice and translating the business intelligence framework explained earlier in Chapter 4.2. Correlation between the process model and the layers of business intelligence framework is summarized in the following Table 2:

Table 2 - Correlation BI Framework and Process Model

BI Process Model Step	Explanation	BI Framework Layer	Research Activity	Deliverable
Defining intelligence needs	This step involves identification of the quality definition, which will direct the focus of this research	Vision, strategy	Literature study, Initial expert interview	Literature review
Information gathering	-Analyze previous research works in education quality about factors that affect education quality -Investigate factors that affect education	CSF, KPI	Literature study, Expert interview, Questionnaire	Education quality framework

BI Process Model Step	Explanation	BI Framework Layer	Research Activity	Deliverable
	quality based on best practice			
Information processing	Connect the gathered information and translate into measurable way of communicating them			
Analysis	Identify available (and not-available) measurement data relevant to identified CSF and KPI		Feasibility analysis through expert interview	IS data model
Dissemination	Connect data to components of the framework	Dashboard		Dashboard mockup
Utilization and feedback	Translate data into a practical way of communicating information gathered			

Chapter 5 – Education Quality Model

This chapter begins by explaining the interview result conducted which will be the base for continuation of this research, as described in Chapter 5.1. Chapter 5.2. elaborates on the critical success factors generated based on the interview result and combined with literature study. Next, the initial framework is presented in Chapter 5.3.

5.1. Interviews

As an initial step for this research, semi-structured interviews were conducted with interviewees that have expertise in education sector. The number of interviews conducted was not predetermined, but instead interviews were conducted until a so-called theoretical saturation is achieved. Glaser and Strauss (as cited in Guest, Bunce, & Johnson, 2006) defined theoretical saturation as the point at which no additional data are being found that could develop properties of the category, or in another word, where no new information could be added. For this research, seven were found to be sufficient to reach theoretical saturation in the initial interview as a starting point for this research. Semi-structured interview methodology is chosen because the interviews were intended to be explanatory, and semi-structured interview gives more flexibility in directing the interview as needed and having a discussion in a form of conversation. Each interview lasts ranging from 45 minutes to 1.5 hours. The overview of interviewees involved is summarized in Table 3.

There are no strict guideline and list of questions for the interview, but should cover a certain pre-determined topic. Because they were initial interviews, the topics prepared include:

1. General explanation about the Dutch education structure, both in general and specifically secondary education.
2. Understanding how education quality could be best described in the field of secondary education.
3. Discovering the important stakeholders that should be taken into consideration in measuring education quality.
4. The important components in education process that affect quality of education.

At the end of the interview, interviewees were left with a long list of indicators about education quality which is gathered from previous research works about education quality. Interviewees were asked to give rating and choose what indicators they consider important and relevant in the context of secondary education in the Netherlands. The result is being used in building the framework which will be elaborated in Chapter 5.3.

Table 3 - Overview of the Interviewee Profiles

Expert	Position	Affiliation	Description
1	Senior policy advisor	CVO School Group – Rotterdam	Interviewee is responsible for education quality assurance in CVO School Group which has around 20.000 students
2	Senior policy advisor	CVO School Group – Rotterdam	Interviewee is responsible for education quality assurance in CVO School Group which has around 20.000 students
3	Education management professional	Independent	Interviewee is an independent education management professional, a researcher and advisor in education quality, and has published number of papers about education quality in the Netherlands
4	Director of accreditation service	Council of International School (CIS)	Interviewee has been actively involved in setting up guidelines and conducting accreditation of secondary schools around the world
5	Co-founder	Bijcollege	Bijcollege is an education quality assessment organization in the Netherlands, has been actively involved in projects for assessing schools' education quality. Currently, quality assessment projects conducted are focused in the higher education level
6	Associate Partner	Passioned Group	Interviewee the co-creator of *De Onderwijscockpit* – a dashboard to measure education quality in the primary school which supports the PDCA cycle. Passioned Group is analyst and consultancy company specializing in business intelligence, data integration, and ETL tools.
	Director	Franeker Management Academie	
7	Owner	Coaching & Consultancy in Education Management	The coaching and consultancy firm helps school leaders monitor education quality through educational scorecard (which is based on balanced scorecard). Interviewee was an advisor in PO Raad, and is the co-creator of *De Onderwijscockpit* – a dashboard to monitor education quality in primary school which supports the PDCA cycle.

5.1.1 Quality in the Context of Secondary Education

The first part of the interview was used to understand the education system structure in the Netherlands, and furthermore to understand how education quality could be described and related to the categorization by Harvey and Green (1993). Based on these discussions, it could be confirmed that the current understanding of Dutch education system and school organization as described in Chapters 3.1. and 3.2. are correct. Expert 6 also explained that majority of students in the Netherlands immediately go to labor market after finishing their secondary education, instead of going to higher education.

The discussion then continues to investigate the interviewees' opinion about how to identify a good education quality with regards to the five quality dimensions. Firstly, the dimensions were explained briefly, continued with a discussion about education quality definition in an exploratory manner. Because the aim is to explore their view about education quality, interviewees were not asked explicitly to describe a definition of education quality.

According to expert 5 that has been involved mostly in higher education assessment, school with good quality is the one that fulfills national standard as well as their own school profile which relates to third dimension of fitness for purpose. Expert 4 mention that continuous improvement is very important in having good education quality which is aligned with the first dimension of quality as exceptional. Teaching process should also be focused on, which is aligned with the dimension of quality as perfection or consistency. Interesting enough, none of the interviewees answers point at quality as value for money.

Furthermore, the largest portion of discussion about education quality definition directs towards the fifth dimension of quality as transformation. All interviewees mentioned the importance of enhancing students with knowledge and preparing them for education continuation through empowerment. Aside from cognitive development of students, it is also very important to focus on the social development of students. Students should be able to function well in society, and school should help students to identify their potential and make the best out of each student (Experts 1, 2).

Based on the findings, this research continues by focusing on the fifth dimension of education quality which is quality as transformation.

5.1.2 Stakeholders

From the interviews conducted, there are variations in the identified stakeholders with four overlapping stakeholders that all interviewees listed as the important stakeholders. The four stakeholders are (1) Students (2) Teachers (3) School management (4) External stakeholder, which includes parents and future employers; with the emphasis is mostly on teacher. Note that the term future employer in this context is not limited to only people from the labor market that will employ graduates of school, but also the continuation level of education related. As the focus of this research is on secondary education, therefore the continuation level of education would be the higher education (university level). Aside from these stakeholders, some interviewee also listed government, non-teaching staff, alumni, and society – which is a very broad term – as stakeholders that should be included in assuring education quality.

The identified stakeholders list from interview is aligned with previous research works in education quality such as Owlia & Aspinwall (1998); Gibbs (2010); Chua (2004); Harvey & Green (1993); Scheerens et al. (2011); Horsburgh (1999); and Zakuan, Muniandy, Saman, Ariff, Sulaiman, & Jalil (2012). However, some other stakeholders that are featured in literature review did not come up during interview. This includes prospective students and external examiners such as quality auditor, assessor, and accreditation professional (Cheng & Tam, 1997; McKay & Kember, 1999; Harvey & Green, 1993). This research will continue with the four identified stakeholders based on interview.

5.1.3 Components

According to the interviewees, there are generally four components that could be identified and taken into consideration in assuring good quality of education. These components are (1) Curriculum, (2) Student, (3) Teacher, and (4) Circumstances. Circumstances include the organization factor of the school, the environment where the school is, government, and other components affecting education process.

All interviewees agree that teachers are the heart of education and play the most important part in education process. Teaching and learning process doesn't always have to be conducted in a fancy building with excellent condition books as long as teacher could deliver the teaching material well, as stated by Experts 3 and 6. Therefore the most important component in assuring education quality relies heavily on teachers, with the focus on the ability of teachers to connect with students. This includes the communication skill of teacher, effectiveness of teaching method, the ability of teacher to inspire and provoke his/her students to learn, and understand student needs. That is why it is very important for teachers to have empathy and connect emotionally with their students. Aside from this, teachers' qualification and experience in teaching is also very important in assuring a good education quality.

Naturally, the organization plays a very important role in assuring good education quality by making sure that the school has good teaching and learning quality, and in assuring continuous improvement. This should be included in the school (and organization) goal which are defined in the school's mission and vision statement. That is why leadership and management are very important as they would guide and direct school activities towards good education quality (Expert 4).

5.2. Education Quality Success Factors

Many research studies have been conducted in the topic of education quality and how to improve it by identifying the characteristics of a good education quality. However, these previous research works tend to focus more on higher education level (i.e. university level) and not many research on secondary education level are available. Therefore this research tries to synthesize and compare components from previous research works that are considered relevant, and identify success factors that should be included in assuring education quality in secondary school level.

Selection of the previous works is based on the identification made in the expert interviews, with regards to the definition of quality, component of education, and stakeholders. These publications are chosen as closely as possible to relate to what is described in section 5.1. Another criterion is to choose the available publication from Dutch organization that deals with measuring education quality, as the context of this research is focused on Dutch Secondary Schools.

One of the characteristics lists included here is the one provided by Quality Assurance Agency for Higher Education (QAA). QAA is an independent agency in the United Kingdom with their mission statement is to safeguard standards and improve the quality of UK higher education. The QAA guideline used in this research is solicited from the work of Becket & Brookes (2006) and Borahan & Ziarati (2000; 2002) as they include this guideline in their researches.

A guideline also included in this comparison identification is the characteristic of a good school provided by '*Excellente Scholen*' (literally, excellent school), which is a Dutch organization that gives award to schools with good performance. The award is given yearly to schools in the primary and secondary levels of education. They provide a list of characteristic that a certain school should have in order to be recognized as an excellent school.

Another guideline that is included in this comparison is the one used by Council of International Schools (CIS) (2013), a global non-profit membership organization which manages international schools around the world. They provide accreditation service for their member schools, with the main drivers being teaching and learning quality; internationalism; and mission, vision, and values of each school.

Table 4 shows a comparison and grouping of the characteristics based on previous research and education quality guidelines used by different organization. Based on this characteristic grouping, critical success factors for this research are generated. Each factor identified based on the comparison will be explained in the next section in alphabetical order. It is important to establish that the factors are not presented based on the importance level.

5.2.1 Curriculum Organization

Curriculum organization is a very important success factor for schools in the Netherlands, because the Dutch government only sets a certain target that schools have to achieve. As to the process of achieving those targets, every school has complete independence in using any approach they see fit, as explained by Experts 1, 2, and 3. Expert 6 also emphasize on the importance of curriculum so that it should be considered a separate factor, rather than view it as integrated in the other factors. Therefore, in assuring education quality in the Netherlands, curriculum organization plays a very important role.

Aligned with the interview result, literature review also showed that curriculum is considered important as it is included in all previous researches and guidelines used for this research. Curriculum organization includes design of curriculum, content of curriculum and its philosophy. In their work, Gatfield, Barker, & Graham (1999) include 'academic instruction' as a factor. This factor consists of 10 variables which includes course content, intellectual stimulation, and variety of courses. Course content should contain relevant curricula, primary knowledge, and relevant for student's future (UNESCO, 2004; Owlia & Aspinwall, 1998; Chua, 2004; Borahan & Ziarati, 2002). Providing students with clear goal and standards also affect student to learn effectively (Ramsden, 1991; Council of International Schools, 2013), which

Table 4 - Education Quality Success Factors

Owlia & Aspinwall (1996)	Gatfield, Barker, & Graham (1999)	Horsburgh (1999)	CIS Guide to School Evaluation and Accreditation	QAA	Chua (2004)	Excellente Scholen	This Research
Attitude	Guidance	Teaching staff and how they teach and assess	Faculty and Support Staff	Student Support and Guidance	Concern for Students	Organization of the Educational Process	Teacher Attitude
Competence					Professor's Knowledgeability		Teacher Competence
Delivery	Academic Instruction		Teaching and Learning	Teaching, learning	Teaching and Learning		Delivery Method
					Instruction Medium		
		The curriculum intent and philosophy			Content and Delivery of Course Units		Curriculum Organization
Content				Curriculum Design, Content, and Organization	Accuracy of Curriculum Content		
Tangibles	Guidance		School Guiding Statements	Learning Resources			School Infrastructure
	Campus Life	Resource Issues	Operational Systems				
			School Culture and Partnerships for Learning	Quality Management and Enhancement	Social Activities		Organizational Support
	Academic Instruction	Teaching staff and the environment which they teach	Access to Teaching and Learning			The Circumstances in which the School Works	
		Program Specific Internal Quality Monitoring				Relation Between the Organization of the Educational Process and Result	
	Recognition					School Excellence Policy	
Reliability		Leadership	Governance and Leadership				
		Student Expectations		Student Progression and Achievement	Financially Rewarding Job		Student Achievement
					Placement		
					Academic Performance	Exam Result	
				Assessment	Assessments		

requires proper design and planning of curriculum (Borahan & Ziarati, 2002). Teaching materials should also keep updated, as students appreciate lecturer who does (Zachariah, 2007).

5.2.2 Delivery Method

As explained before, experts found that the ability of teacher to connect with student is very crucial in assuring good education quality, which involves how teacher deliver teaching material to students. This is supported by literature, where all literature used also include this as a characteristic of a good school. Different terms are identified from the literature, where some also include it in a more general factor such as teaching and learning as seen in CIS (2013) and QAA Guideline. As suggested by Horsburgh (1999), student's learning experience is highly impacted by how teacher teach. Clarity of explanation, the level at which the learning material is pitched, and clear teaching organization and goals (Ramsden, 1991) are very important and could determine the quality of the teaching process. Other aspect viewed relevant for this CSF include 'instruction medium' (Chua, 2004), course should be offered in proper sequence (Mergen, Grant, &Widrick, 2000), and 'effective presentation' (Owlia & Aspinwall, 1996). However, study found that there is no single instructional strategy that is successful, teachers who are able to use a broad repertoire of approaches skillfully are typically most successful (Darling-Hammond, 1999). Students should also be given an opportunity to become involved in taking responsibility for their own learning (Borahan & Ziarati, 2002). This is relevant to the fifth dimension of education quality by Harvey & Green (1993).

5.2.3 Organizational Support

In the context of this research, organizational support includes all policy and regulations made by school management – both school and school group level. Support from the organization is very important, with regards to quality control and assuring that regulations are set to support education process fully (Scheerens et al., 2011; UNESCO, 2004). Recognition of school and having a good reputation is also included here, as it is considered one of the characteristics of good school according to Gatfield, Barker, & Graham (1999) and the guideline of *Excellente Scholen*. Organizational support also includes quality management policies applied to teachers, non-teaching staff, and students; which will assure a good school climate for education process (Expert 6). Furthermore, schools should pay attention on students with low-ability by allocating additional resources for those students, as it will help improve their performance (de Haan, 2012; Card & Payne, 2002).

5.2.4 School Infrastructure

Tangibles also play an important role in having a smoothly conducted learning process. Student would be able to have optimal learning experience when there are sufficient facilities supporting the education process. This includes availability of classrooms, required equipments such as computer and laboratory, and also a clear guideline for students (UNESCO, 2004). Paying attention to the size of a classroom is important as it allows more attention given by teacher towards students. Achilles and Shiffman (2012) show the positive effect of this situation specifically in primary school by conducting an experiment called STAR. However,

experimental research comparing the effect of small class size also shows a positive effect on secondary school students (Blatchford, Bassett, & Brown, 2011).

The condition of the school building itself has the effect on teaching and learning effectiveness. Comfortable classroom temperature and noise level are very important to efficient student performance; as students attending schools in better condition outperforms students in substandard buildings (Earthman, 2002). Furthermore, facility with good quality affects the school climate which impacted student achievement (Uline & Tschannen-Moran, 2008). Not only does facility quality affect student achievement, it also affects teacher performance. And interestingly it also affects teacher's decision in staying at a certain school and not considering moving to teach at a different school (Buckley, Schneider, & Shang, 2004).

5.2.5 Student Achievement

The quality of education could clearly be seen from what the students achieve after undergoing the education process. This is a very interesting subject as it is currently being a political highlight in the Netherlands (Experts 6, 7). Literature study also shows that this is a very important aspect to highlight as it shows the product of education process, which could be seen through student academic result, transition from school to work (e.g., youth unemployment and employment by level of education attainment), and the social and labor-market outcomes of education (Scheerens et al., 2011; Gibbs, 2010). Other terms used in different research works include student progression, performance and degree classification, and retention and persistence.

Aside from the study result, the preliminary assessment of student's knowledge is seen to be important, which include creating an admission requirement and appropriate faculty qualifications to filter selection of students (Chua, 2004; Mergen et al., 2000).

5.2.6 Teacher Attitude

Teacher is the heart of education, therefore it is very crucial for teachers to have positive attitude. As discovered from interviews, teachers should be able to communicate and connect emotionally with student as their behavior in classroom affects how student receive education (Darling-Hammond, 1999). They should be able to motivate, understand, and give guidance to their students. As seen in Table 4, all research includes this factor as one of the characteristics of a good school.

This includes having teachers that could connect emotionally with student, have empathy, and are open to student (Experts 1, 2, 3, 5; Ramsden, 1991; UNESCO, 2004). Several ways could be used in measuring teacher effectiveness and attitude including student, peer, alumni, employer, and/or administrator ratings, self evaluation, and student interview (Berk, 2005); but it is proven that alumni and student ratings evidence substantially greater validity than self evaluation, colleague, and trained observer ratings (Howard, Conway, & Maxwell, 1985).

5.2.7 Teacher Competence

As solicited from interviews, teacher plays a key role in assuring the education quality as they are the heart of education, as stated by Experts 1 and 2. Therefore, it is very important to assure competency of the teacher. Expert 3 explains that teacher's qualification, in terms of the level of teacher's previous education, is an important aspect to focus on to assure the quality of teacher. This is also supported by literature study as stated in Owlia & Aspinwall (1996) which includes competence as one of the required factors for education quality, while Chua (2004) identifies this characteristic with the term 'Professor's Knowledgeability'.

Darling-Hammond (1999) in her research shows that differential teacher effectiveness is a strong determinant of difference in student learning, far outweighing the effects of differences in class size. Variables that affect teacher's competence include measures of academic ability, years of education, years of teaching experience, certification status. Furthermore, she concluded that "when student characteristics are held constant, the relationship of teachers' qualifications to student achievement is even more pronounced … [as study] found that differences in teacher qualifications (educational degrees, certification status, and experience) accounted for approximately 90% of the total variation in average school-level student achievement."

In the Netherlands itself, teacher qualification system is already in use in secondary schools to differentiate their competence. The qualifications include 1st degree teacher, 2nd degree teacher, under qualified, and unqualified teacher. This differentiation is done based on the education that they have received, where 1st degree teacher being the highest qualification.

5.3. Initial Framework

As explained in section 5.1., the interviewees were asked to give ratings on a list of indicators gathered from previous research work on education quality. The selection of research publication selected includes Becket & Brookes (2005); Borahan & Ziarati (2002); Chua (2004); Gatfield, Barker, & Graham (1999); Gibbs (2010); Horsburgh (1999); Owlia & Aspinwall (1998); Tam (2001); and Widrick et al. (2002). The ratings given was based on a 5-points Likert scale according to their importance, where 1 being very unimportant and 5 being very important. Furthermore, they were also asked to add other indicators that they find relevant in this context but not yet included in the list. The aim of this process is to see what indicators are considered important by the experts, which is used as a base for creating the initial framework.

The information gathered about the importance of indicators is then combined with the identified CSFs to create a framework constructed with a list of performance indicators. Each performance indicator is linked to a suitable critical success factor. These performance indicators are listed along with the possible measurement and potential data source needed, as shown in Table 5.

Table 5 - Initial Framework

Component	CSF	KPI	Measurement	Data
Teacher	Teacher Competence	Teacher's education and training	- Teacher has received training and education in pedagogic and didactic field - 75% teachers are in the group of highly qualified teachers (1st degree)	- Teacher's education background record - Teaching level qualifications
		Teacher holds a diploma aligned with the subject they teach	85% teachers teach the subject with particular diploma they hold	- Teacher's education background record - Teacher's course record
		Teacher's teaching expertise	Number of years teacher has taught a particular subject	Teacher's teaching history record
		Teachers are involved in continuous learning	Teachers go to regular (yearly or half-yearly) conferences about their field	- Number of days teachers go conference in their field - Amount of money spent allocated for teacher learning and improvement
	Teacher Attitude	Highly motivated teachers	Teacher's attendance rate> 90%	- Teacher's absence frequency - Teacher's absence duration - Teacher and student survey
		Teachers have the ability to understand student's need	20% teachers has this ability, which allows peer group learning	Teacher and student survey on teacher's performance
		Teachers have the ability to encourage and motivate student	Student has high attendance rate	- Student survey on teacher performance - Student's absence record (frequency and duration)
		Teachers are emotionally involved with students	- 80% students opine so - Teachers receive good assessment from school management	- Student survey on teacher performance - Teacher's performance review from management
Curriculum	Curriculum Organization	School curriculum meets government standard	Government targets and standards are fulfilled	- Teacher survey - External assessment
		Teaching materials are up to date	Textbooks and study guides are from the last 5 years, or the most recent available	- Teacher survey - Course description
		Curriculum should contain primary knowledge	Materials necessary for aptitude (CITO) test should be covered in the curriculum	- Teacher survey - Management survey - External assessment

Component	CSF	KPI	Measurement	Data
		Curriculum are properly designed and planned	Teaching and assessment plan are detailed into hours and should be available before each quarter starts	- Teacher survey - Course description associated to teaching plan
	Delivery Method	Usage of effective presentation method	At least 80% of students understood the material at the end of study hour	- Student survey - External assessment - Student quiz result at the end of contact hour
		Actively involving student into the process of pursuing knowledge	Classroom average of 7 or higher in assignments that require independent study and decision making	- Course description (explains the nature of the course) - Student test results
		Pay attention to the logical structure of teaching material	Monthly checkpoints on teaching plan that assures there is a build-up on the knowledge	- External assessment - Student and teacher survey - Yearly review
		Usage of methods that improve students' communication skill and team-working	Classroom average of 7 or higher in presentation and group assignments	- Course description (explains the nature of the course) - Student test results - External assessment
Organization	School Infrastructure	Sufficient space and available classroom	- School has sufficient space for every student - School has extra room available for unscheduled splitting of class	- Average student per classroom - Average square meter each student has in the classroom (enough space to move) - Classroom occupational rate
		Reasonable teacher to student ratio	1:20 teacher to student ratio	- Teacher record - Student record - Course planning
		School facilities and building are of good quality	Yearly school restoration and monthly maintenance control	School maintenance record
		Availability of guidelines for students	Students provided with a contact person (study guide advisor) that is available when facing a problem	- School guide - Personnel record - Student survey
	Organizational Support	Attention given by school to students in accordance to their socio-economic status	Students with lower socio-economic status receives extra financial subsidy	- Student record - School profile (percentage of student that requires special attention)

Component	CSF	KPI	Measurement	Data
		Quality management policy regarding Human Resource of the school	Availability of guideline that assures the well being of both students and staff, which include addressing the support provided for students with special needs	- School regulation - Teacher and student survey - External assessment
		Clear evaluation of students' development progress	- Quarterly exams with monthly routine tests - CITO test	- Curriculum and academic calendar planning - CITO test score
		Well recognized school and reputation	- School receives award in the last 5 years - School achieve a positive review	- Excellente scholen - Elsevier's de beste scholen
Student	Student Achievement	The initial level of student's knowledge meets the school's entrance requirement	Student's CITO exam result should match the entrance requirement	- CITO scores - School level entry requirement - Advice from primary school
		High pass rate of student in each school level without having to re-sit a certain level	80% of students progress smoothly in their education continuation	Student profile record
		Students shows retention and persistence in their performance	Students has increasing test result throughout the year, or at least are in the same level with previous test	Student exam result (CITO, central exam, school exam)
		Students are able to continue to the next level after finishing their education	90% of students has a final exam score that is sufficient for them to be accepted in the higher education level	Student exam result

Chapter 6 – Validation of Framework

For the validation of framework, an online survey was conducted on secondary school directors through questionnaire. In the questionnaire, respondents are provided with the CSF and KPI list from the initial framework as seen in Table 5. For each KPI they were asked to give a rating using 5 points Likert-scale with regards to the importance, where 1 being very unimportant and 5 is very important. Furthermore, respondents were asked to submit additional KPI if necessary. The goal of this online survey is two folds: (1) to check if the framework created are found to be suitable in the daily school activity environment; and (2) to see the prioritization of KPI CSF and components in practice in assuring a good education quality.

Chapter 6.1. explains the profile of respondents for this survey. In Chapter 6.2. different analysis conducted based on several categories is explained, while Chapter 6.3. shows the validated framework of this research.

6.1. Profiling of Respondents

Invitation was sent out to 244 directors from all types of secondary school. Schools were chosen based on their rank given by Elsevier rank of good schools. In 2013 Elsevier published a rank of good quality secondary schools in the Netherlands, titled '*Beste Scholen*'. This school ranking system is based on the standard provided by Education Inspectorate, and depicted with a 5-points scale between -- (very bad quality), - (bad quality), +/- (neutral), + (good quality), and ++ (very good quality). The schools chosen for this validation purpose are the ones that receive good ratings. Priority goes to schools with ++ score, and followed by schools that have many + on their different school types. Furthermore, schools that received *'Excellente Scholen'* award are also chosen.

Choosing these schools assure that the ratings received on the KPI are from schools which are already acknowledged as having good quality. It also assures that the ratings given are based on what they know works in practice, which will also assure validity of the framework.

From the invitation sent out, 35 responses were received from directors of different school types. In general, one respondent manages more than one school type. But there is one respondent who manages only one school type. Furthermore, there also exist two respondents who is a director of *Praktijkonderwijs School* which is out of the scope of this research. But since he also manages other type of schools which are relevant to this research, the response is still included in the analysis. The list of respondents' school type and the related information is summarized in Table 6.

For the purpose of analysis, different school types are grouped into two categories: practical and theoretical groups. Theoretical group includes HAVO and VWO level schools, while practical group consists of the VMBO level schools. Some schools that have VMBO-t, HAVO, and VWO level in their school are included in the theoretical group in this analysis. This decision is based on the consideration that VMBO-t is emphasized more on theoretical studies compared to the other VMBO levels.

Table 6 - Survey Respondent Summary

School Type Directed	Number of Students	Province	School Area
HAVO, VWO	1326	Limburg	South
HAVO, VWO	1571	Limburg	South
VMBO-t, VMBO-k, VMBO-b, HAVO	334	Zeeland	South
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO, Praktijkonderwijs	3100	Zeeland	South
VMBO-t, HAVO, VWO	615	Groningen	North
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO,	265	Friesland	North
HAVO, VWO	722	Groningen	North
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	2100	Limburg	South
VMBO-t, VMBO-k, VMBO-b	1000	Drenthe	North
VMBO-t, VMBO-k, VMBO-b	530	Gelderland	Centre
VMBO-t, HAVO, VWO	1600		
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	1650	Noord-Holland	North
HAVO, VWO	1500	Noord-Holland	North
VMBO-t, HAVO, VWO	1325	Utrecht	Centre
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	2460	Utrecht	Centre
VMBO-t, VMBO-k, VMBO-b, LWOO	611	Utrecht	Centre
HAVO, VWO	1500	Utrecht	Centre
VMBO-t, HAVO, VWO	1800	Utrecht	Centre
HAVO, VWO, VWO-plus	1500	Utrecht	Centre
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO, Praktijkonderwijs	5300	Zuid-Holland	Centre
VMBO-t, VMBO-k, VMBO-b	510	Gelderland	Centre
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	2.025	Zuid-Holland	Centre
VMBO-t	433	Friesland	North
VMBO-t, HAVO, VWO, TVWO	667	Flevoland	North
VWO, gymnasium	1170	Zuid-Holland	Centre
VMBO-k, VMBO-b, vmbo gl	n/a	Noord-Holland	North
Gymnasium	1863	Zuid-Holland	Centre
VWO	825	Noord-Holland	North
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	1850	Utrecht	Centre
VMBO-t, HAVO, VWO	n/a	Noord-Brabant	South
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	1400	Flevoland	North
VMBO-t, HAVO, VWO	n/a	Noord-Brabant	South
VMBO-t	350	Zuid-Holland	Centre
HAVO, VWO	1200	Noord-Brabant	South
VMBO-t, VMBO-k, VMBO-b, HAVO, VWO	1850	Gelderland	Centre

6.2. Analysis Result

In the questionnaire, respondents are requested to add other relevant KPIs that are not included in the initial framework for each CSF. From the feedback received, only two respondents added three extra KPIs (in total) to the list. When analyzed, all three indicators are already represented by the other KPI in the list and are a rephrasing of the same purpose. Therefore it is not necessary to add extra KPI to the existing list, and it is considered complete.

6.2.1 General Response

The first analysis performed is to see the average score of the survey respondents in general. For each CSF, an average score is calculated from the total response received with the result as shown in Table 7. For each CSF the Cronbach's Alpha value is calculated using SPSS 17 to test inter-item reliability, which means assuring that individual items would produce results consistent with the overall score. Cronbach's Alpha value is calculated for the KPI constructing each CSF. Value of Cronbach's Alpha around 0.7 and greater indicates a reliable scale (Field, 2009). Since the values of Cronbach's Alpha for all items are in the range, it is acceptable and all factors are considered reliable.

Table 7 - CSF Average Score from Total Respondents

Item Statistics

	Mean	Std. Deviation	N	Cronbach's Alpha
Average score for Teacher Competence CSF	4.0000	.57522	35	.659
Average score for Teacher Attitude CSF	4.3571	.70525	35	.865
Average score for Curriculum Organization CSF	3.8000	.66642	35	.711
Average score for Delivery Method CSF	4.1214	.67348	35	.789
Average score for School Infrastructure CSF	3.8214	.70076	35	.805
Average score for Organizational Support CSF	3.7143	.66183	35	.736
Average score for Student Achievement CSF	3.9071	.54262	35	.627
				.916

A bar graph is presented in Figure 10 to give an overview of the average scores of the CSFs. It could be seen that each CSF is scored quite highly – around 4 in a scale of 1-5. This is quite expected as the CSF list was derived based on interview with experts in the education quality field, and the most important factors and components were chosen. Therefore, respondents might find every factor to be important in assuring education quality. From test descriptive, the two most important CSF listed are 'Teacher Attitude' and 'Delivery Method'.

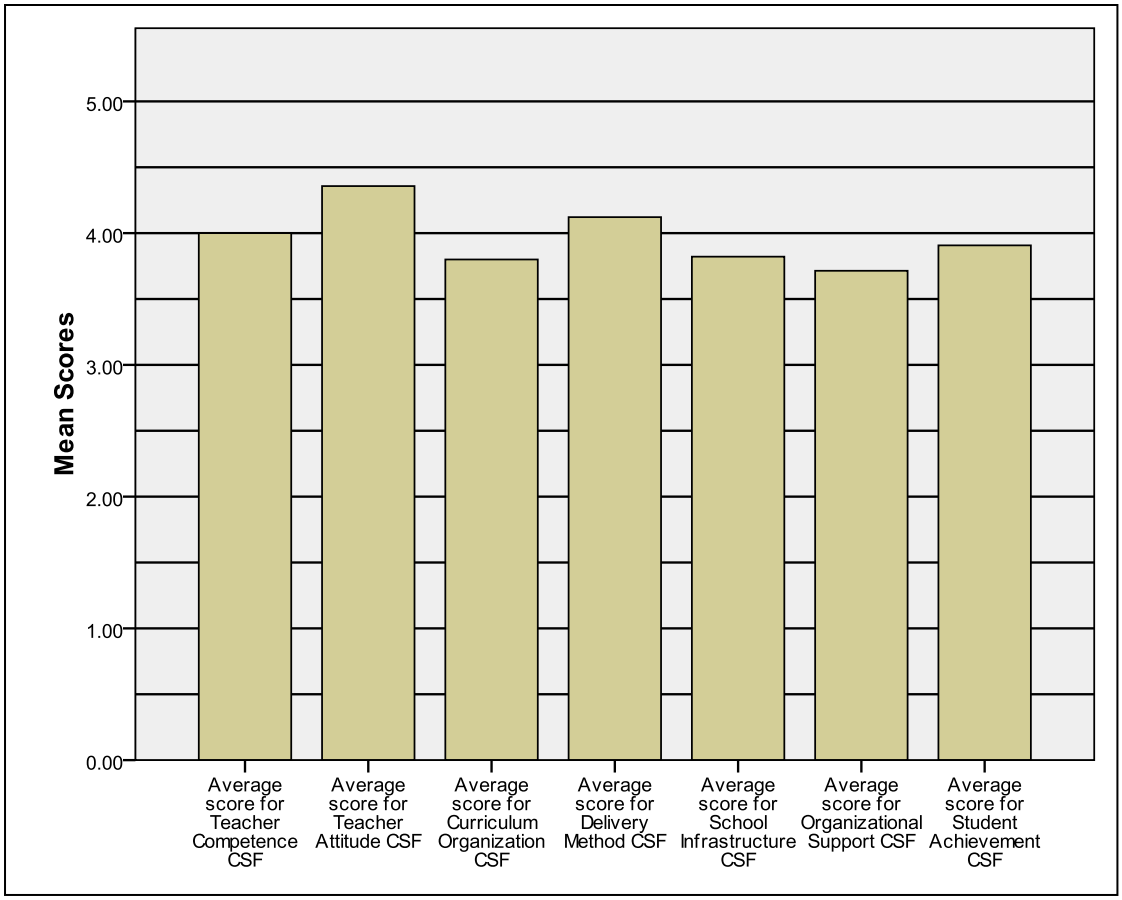

Figure 10 - Bar Graph for Average CSF Scores

6.2.2 Analysis per School Type

Further analysis is done on different school type groups. For this purpose, respondents are differentiated into two groups based on their school type: theoretical and practical schools. Schools that have VMBO-t, HAVO, and VWO levels in their school are included in the theoretical group. As well as schools that only have HAVO and VWO levels. All VMBO schools are included in the practical group. VMBO-t is included in either theoretical or practical group, depending on what other levels are in that school. Based on this differentiation, the theoretical group has 17 schools assigned to it and the remaining 18 schools is included in the practical group.

Summary of the score average from both groups is summarized in a bar graph shown in Figure 11. Because all scores are quite high (above 3.5), this graph uses the minimum value of 3 to give a clearer view of the differences between both groups. A more detailed statistics descriptive of the different groups could be found in Appendix A. Further, a box plot diagram of each CSF is included in Appendix B, with comparison of both groups.

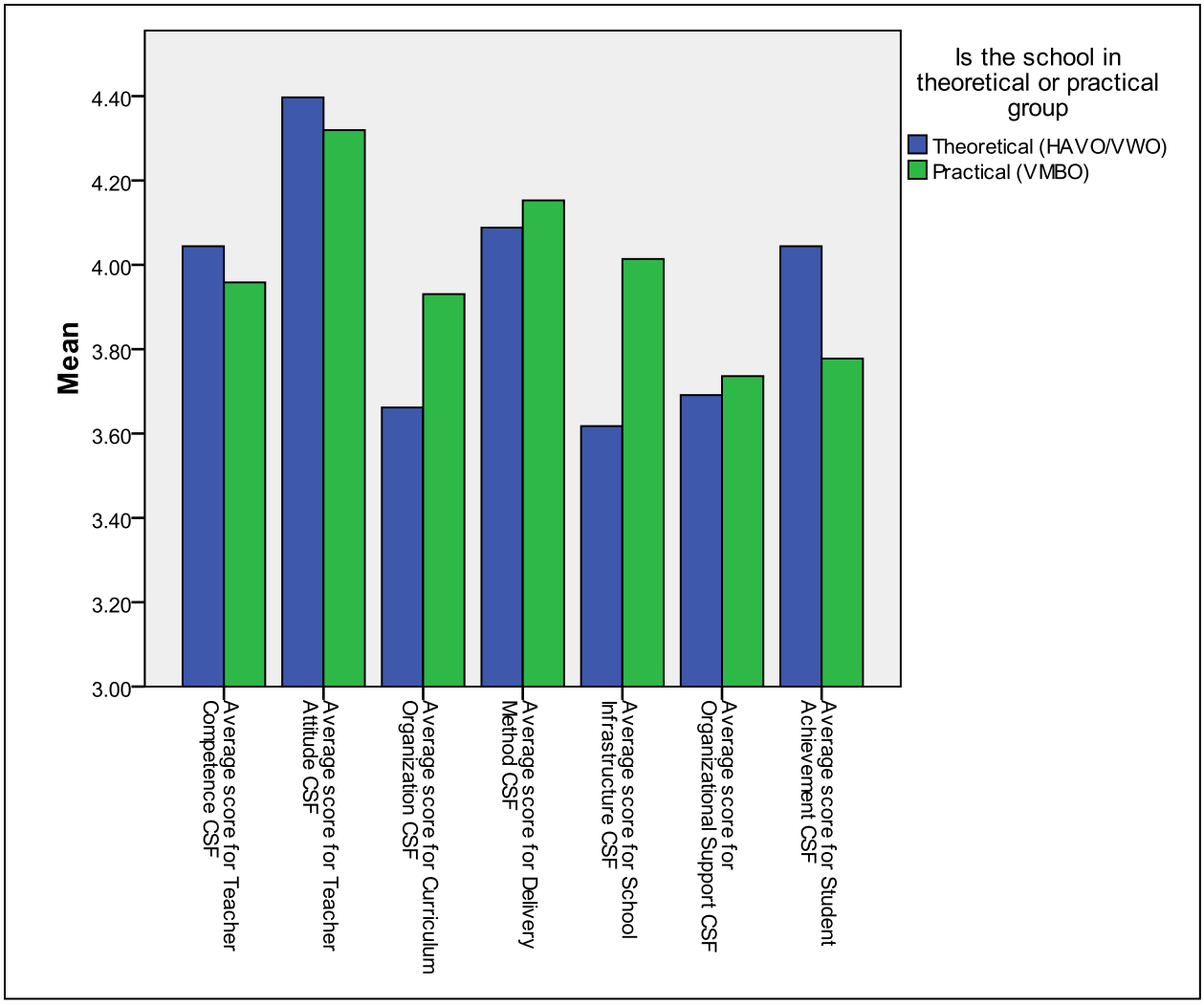

Figure 11 - Bar Graph for Average CSF Scores by School Type

	Theoretical Group Mean Score
Average score for Teacher Attitude CSF	4.3971
Average score for Delivery Method CSF	4.0882
Average score for Student Achievement CSF	4.0441
Average score for Teacher Competence CSF	4.0441
Average score for Organizational Support CSF	3.6912
Average score for Curriculum Organization CSF	3.6618
Average score for School Infrastructure CSF	3.6176

	Practical Group Mean Score
Average score for Teacher Attitude CSF	4.3194
Average score for Delivery Method CSF	4.1528
Average score for School Infrastructure CSF	4.0139
Average score for Teacher Competence CSF	3.9583
Average score for Curriculum Organization CSF	3.9306
Average score for Student Achievement CSF	3.7778
Average score for Organizational Support CSF	3.7361

Figure 12 - Average Score Comparison between Theoretical and Practical Group

A comparison of the average scores of the two groups is presented in Figure 12. It could be seen that for both groups the CSFs 'Teacher Attitude' and 'Delivery Method' is listed as the two most important CSF. A difference is seen in the third CSF for the different group, which are 'Student Achievement' and 'Teacher Competence' – equally – for theoretical group and 'School Infrastructure' in the practical group. This could be affected by the fact that practical schools

focus more on developing student's practical skills which require good quality of facility provided by school.

6.2.3 Analysis based on School's Definition of Quality

Next analysis is to see the difference of score average based on how respondent views quality in education. In the questionnaire, definitions of five different dimensions of education quality (Harvey & Green, 1993) explained in Chapter 3.3. was firstly explained, and then respondent was asked to give their definition of education quality. Respondents could use their own wording in giving the definition, and it is then translated so it could be grouped into one of the five dimensions. From 35 respondents, 33 provide their view on education quality. The analysis is continued with these answers.

Some respondents would answer by choosing one of the definitions, and some would form a sentence that could be aligned with one of the definitions. 14 of the respondents view on education quality are aligned with 'Quality as Transformation'. Some example of the definition in this group include 'Quality as equipment for life', 'Education allows student to shape their future with knowledge and confidence'. Further, 8 respondents view 'Quality as Exceptional', 7 answers 'Quality as fitness for purpose', and 4 answers 'Quality as Perfection'.

The average score for each definition group is presented in Table 8, while Figure 13 gives an overview of the answers through a line graph. From the descriptive table, it could be seen that the two most important CSF in all definitions are 'Teacher Attitude' and 'Delivery Method'.

Table 8 - Average Score Comparison based on Quality Definition

	What is their definition of education quality											
	Quality as exceptional			Quality as perfection			Quality as fitness for purpose			Quality as transformation		
	Mean	Std. Dev	Count	Mean	Std. Dev.	Count	Mean	Std. Dev.	Count	Mean	Std. Dev.	Count
Average score for Teacher Competence CSF	3.81	.97	8	3.94	.31	4	3.96	.57	7	4.13	.38	14
Average score for Teacher Attitude CSF	4.13	1.29	8	4.38	.25	4	4.46	.49	7	4.50	.43	14
Average score for Curriculum Organization CSF	3.66	.74	8	4.13	.60	4	4.00	.38	7	3.75	.77	14
Average score for Delivery Method CSF	4.06	1.11	8	4.25	.54	4	4.11	.45	7	4.16	.59	14
Average score for School Infrastructure CSF	3.94	.90	8	4.13	.32	4	4.07	.61	7	3.66	.66	14
Average score for Organizational Support CSF	3.84	.95	8	3.88	.14	4	3.39	.52	7	3.84	.57	14
Average score for Student Achievement CSF	3.75	.86	8	4.00	.35	4	3.71	.49	7	4.11	.38	14

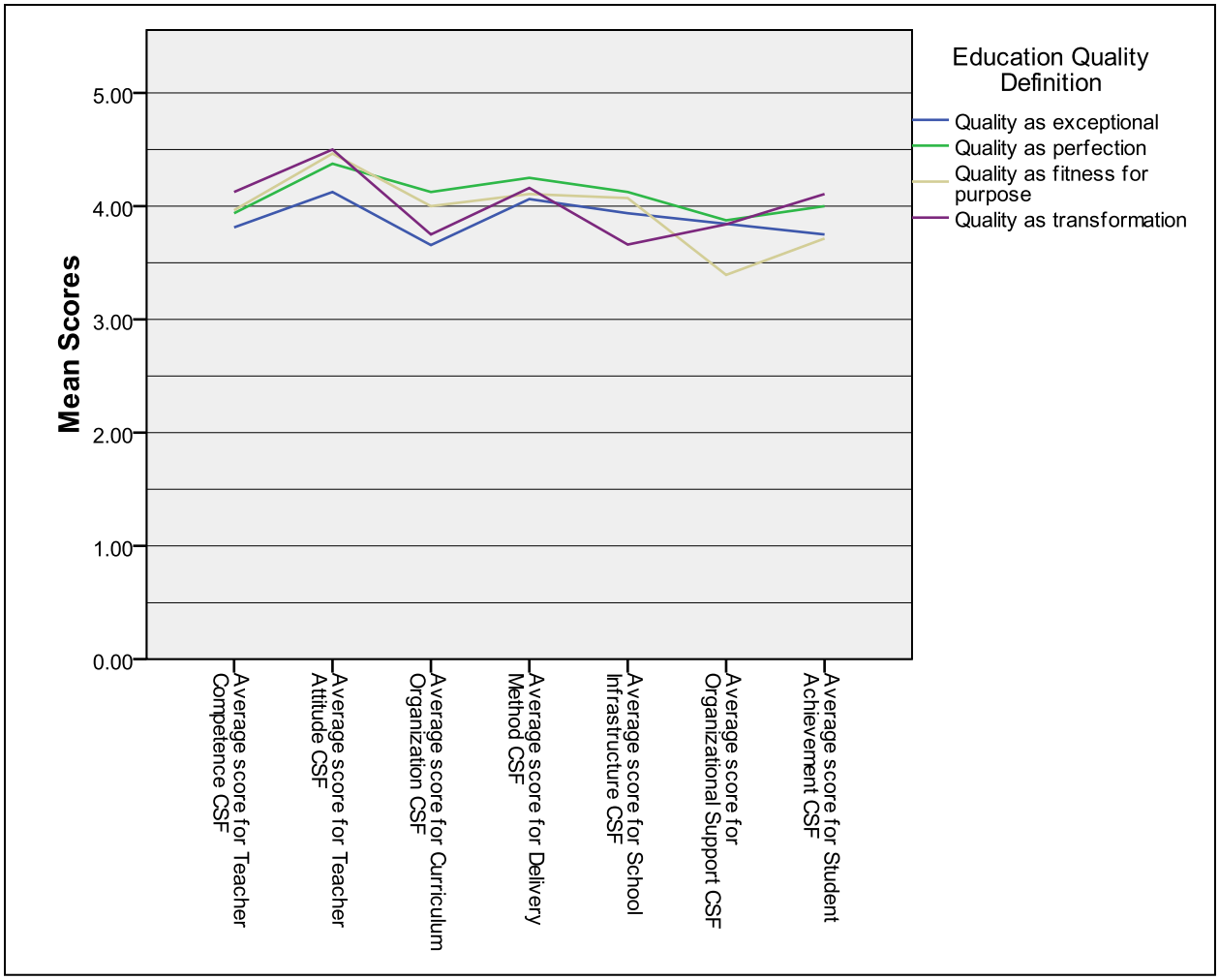

Figure 13 - Line Graph for Average Score by Quality Definition

6.3. Framework Confirmation

In the online questionnaire, respondents are given an option to leave their email address if they want to receive the result of analysis and compare their response to others. This is also used for a validation of the created framework by requesting their confirmation on whether or not they agree with this framework. From 35 respondents, 23 provided their email address and 13 respondents sent back their confirmation. All 13 respondents agree with the generated framework. This is considered sufficient to assure the validity of the generated framework.

Analysis with three different criteria showed that two of the most important CSFs are always the same, which are 'Teacher Attitude' and 'Delivery Method'. This result confirms the statement made by experts during interview that teacher is the heart of education, and it is very important for teachers to be able to connect with students. This would assure a good quality in education; therefore schools should focus on these two factors the most.

The validated framework and its importance based on the different group analysis is presented in Figure 14. CSF importance in the framework is presented in a gradient color scheme, ranging from orange to green. 'Less important' scale is used relative to the other CSF, because from survey it is found that the average score of every CSF is bigger than 3.

CSF	General Score	School Type		Quality Definition			
		Theoretical	Practical	Exceptional	Perfection	Fitness of Purpose	Transformation
Teacher Competence							
Teacher Attitude							
Curriculum Organization							
Delivery Method							
School Infrastructure							
Organizational Support							
Student Achievement							

Figure 14 - Education Quality Framework

Chapter 7 – Framework Feasibility Analysis

The next step in this research is to relate the findings and generated framework to the Information System (IS) it will be implemented in, in this case Capisci. Capisci is an information system created by Datapas BV, currently used in secondary schools. It handles several modules including financial planning, personnel data management, and student's study result. One of the modules offered by Capisci is called the Early Warning System (EWS). This module analyzes school result in the past years and makes a prediction about how the performance of the coming year would be. Currently, the prediction is calculated based on the criteria provided by the *Onderwijs Inspectie* and only takes into consideration the student achievement result. Other components such as teacher and curriculum have not been included in evaluating school performance.

The compatibility between the generated framework and current IS could be analyzed by looking at the measurement and required data summarized in Table 5 in the previous chapter, and match it with the currently available data in Capisci. Furthermore, identification of data that is still needed to satisfy each KPI's measurement requirement is needed. The following sections will elaborate these elements as follow: Chapter 7.1. explains the environment where Capisci works, followed by the data model in Chapter 7.2. In Chapter 7.3., the association between framework explained in Chapter 6 and Capisci is elaborated, and a mockup for dashboard is presented in Chapter 7.4.

7.1. Current IS Environment

Capisci interacts directly with schools as their data source. The data retrieved is from an administration suite called Magister. Magister is an education platform software package developed by School Master (http://www.schoolmaster.nl/) which handles several functionalities important for schools. The functionality offered by Magister provides student data administration including general information, grades, absence, and attendance. Magister also offers functionalities supporting teaching and learning process, such as timetable, course dashboard, digital learning, management reports, and student continuation system (Schoolmaster, 2013)[1]. Aside from Magister, some school use a different administration suite called SOM[2] developed by Simac (http://www.simac.com). SOM and Magister serve the same purpose, but Magister is more widely used as it is more standardized and well-established. Furthermore, these two administration suite does not only manage student information, but also employee information which includes all teaching and non-teaching staff.

[1] Further information about Magister could be found at: http://www.schoolmaster.nl/Voortgezet_Onderwijs.aspx
[2] Further information about SOM could be found at: http://product.simaconderwijs.nl/Onze_producten/SOM

All administration data from school necessary for Capisci is accessed through the school's administration suite (Magister or SOM). This allows Capisci to access all registered records about student's grades, absence, and attendance record, including employee records. Suitable data retrieved and processed for Capisci modules, and the analysis result is presented to school management for them to act upon. As Capisci mainly deals with analysis regarding student performance and employee attendance record, there are more data available from the administration suite not yet utilized in the Current system model. The relation between Capisci and its environment could be translated in the form of a context diagram as shown in Figure 15.

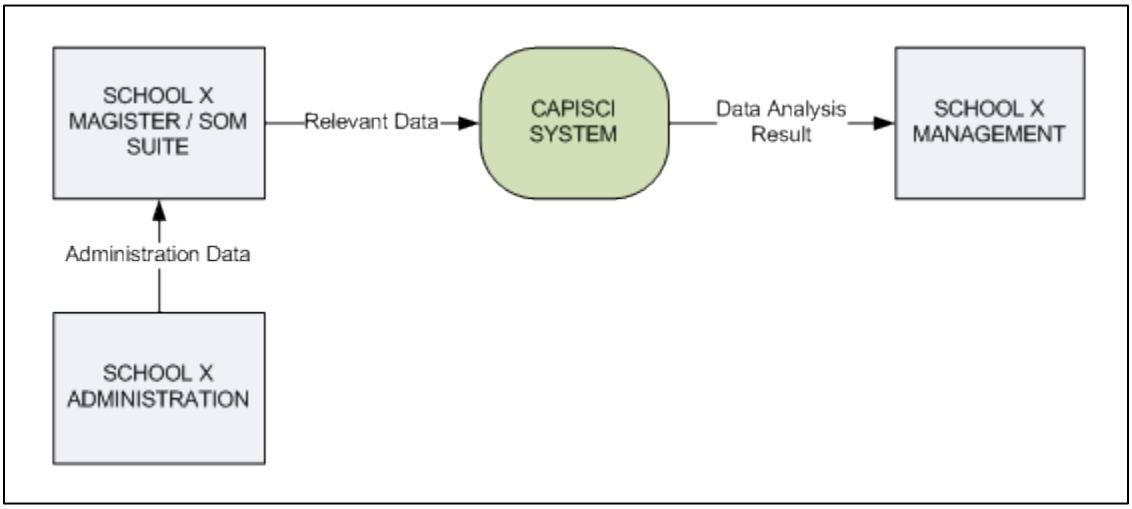

Figure 15 - Context Diagram for Capisci

7.2. Current Data Model

In its data model, Capisci identifies several different components and uses different terms which are related to this research and its data needs. The following explanation describes the definition of each term and how it relates to this research:

1. School : In Capisci, the term school is used to describe the data about each school. This could be related to the component 'Organization' used in this research. School has information about the school as a physical building and the organization of the school itself.
2. Personnel (*personeel*) : Capisci stores information about all personnel working in the school, including teaching and non-teaching staff. This allows the availability of information about 'Teacher' component used in this research.
3. Student (*leerling*) : The same term is used both in Capisci data model and this research with regards to the student. Capisci has various

information available related to students which are relevant to this research.

4. Group (*groep*) : The term group (or could also be associated to the commonly known term ‘class’) is related to the component ‘Curriculum’ of this research. Group is the term used to describe one class which has one teacher responsible for it and has a number of students registered to a group (e.g. group 8 is the last year of primary school, which is attended by students with the age of 11-13).
5. Course (*vak*) : Another relevant term to the component ‘Curriculum’ of this research is course which describes the relevant information to courses offered in the school.
6. Study (*studie*) : Study is also related to the component ‘Curriculum’, where study describes the specific level of the education structure. Study is related to group in a way where each group can only be associated to one study, while one study has several groups related to it.
7. Profile (*profiel*) : Profile is treated as a separate entity in the data model. It holds the definition of the different profiles available for students to follow as explained in chapter 3.1. Further this entity also holds the information about the education type students follow. It is relevant to give a separate explanation of the term ‘profile’ here, as it affects the related course.
8. Score (*cijfer*) : Score is a separate component – represented in a separate table in Capisci database – that holds all exam and assignment data of every course that have been registered. It also holds records from past school years as well.
9. Curriculum (general) : The relationships between different points related to ‘Curriculum’ are summarized in this portion. It is not explicitly stated as a single component in the data model, but for the sake of clarity and ease of identification for this research, they are grouped here.
10. Parent (*ouder*) : Another component which data is available in Capisci is regarding parent. This includes general information about parent’s identity, which student they are related to, and necessary information about financial aspect related to tuition fee debit system.

The data available for each component are summarized in the following Table 9. Further detail of each actual table used in Capisci could be found in Appendices C and D. Further, Figure 16 summarizes the correlation between each component with visual presentation of the data model.

Table 9 - Correlation between Available Data and Component

Component	Derived Data
School (Organization)	- School general information (name, address, bank account) - School type (education level) - Municipality where the school is registered - Classroom type relevant to registered course - Profiling of students with regards to their special need - Relations school has with other schools and/or other external entities
Teacher	- Teacher (personnel) general information (name, date of birth, nationality) - Teacher (personnel) salary - Teacher (personnel) qualifications (indicates the level of teacher's expertise based on their previous education and experience)
Student	- Student general information (name, date of birth, address, nationality) - Student enrollment information: • Education profile student takes • School type student is in • School year/level student is in • Associated courses (primary and elective) • Start and end date of each course associated to student • Student study information - Student progress record - Student absence record - Advised school type to student - CITO score - Extra time student require to complete education - Reason student leave school (in case of moving)
Curriculum (group)	- Description of class (group) - Teacher responsible for a class - Education profile relevant to a class
Curriculum (course)	- Course general information (name, code, relevant education type, duration) - Planned contact hours - Final exam components
Curriculum (study)	- Study general information (name, period, duration) - Study requirement - Possible courses to follow in a study
Curriculum (profile)	- Description of profile - Different profiles available for student
Curriculum (score)	- Course information - Exam result - Assignment result
Curriculum (general)	- School period - Start and end of school year - Duration of education - Student enrollment information (association between profile, course, study, group)
Parent	- Parent general information (name, address, nationality) - Associated student(s) to registered parent

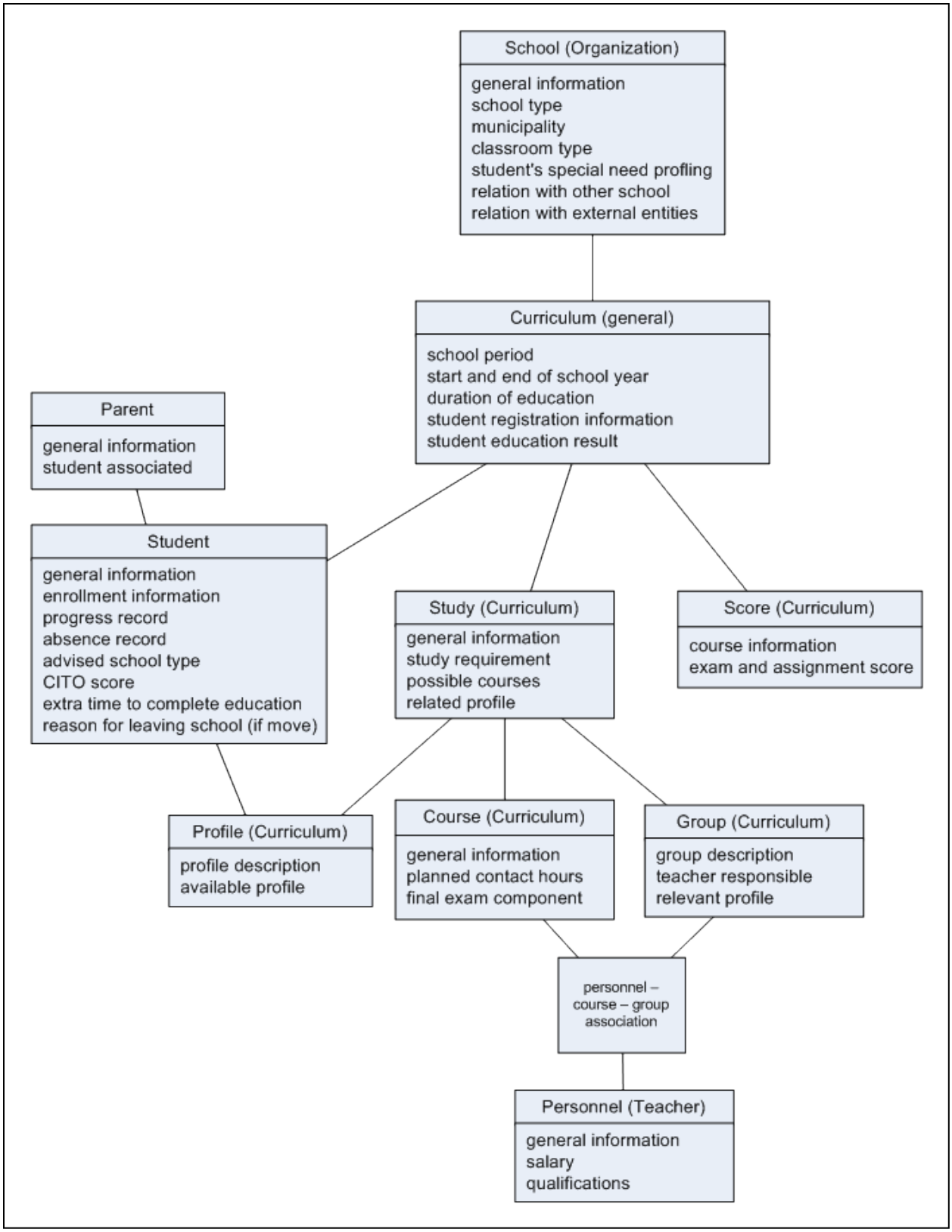

Figure 16 - Capisci Data Model

7.3. Data and Framework Association

The next step is to relate the framework developed to the current Capisci system. This is done through interview conducted with experts from Datapas, who developed the system. The main goal of the interview is to identify what data is available for measuring the components identified in the framework, and what data are still needed. The interview lasted for 90 minutes by going through each item in the framework. The result of this process is summarized in the following Table 10, by showing the association between currently available data in Capisci and the required data for the framework.

It could be seen that there are still some data that are not available for the measurement purpose of this framework. Data that are still required for the implementation of this framework are mainly qualitative data which could be measured through survey and reviews. In his research, Berk (2005) describes 12 different strategies that could be used in measuring teaching effectiveness, which includes self-evaluation, student interview, student ratings, and peer ratings, among others. For this research, these methods could be used especially to measure KPIs related to the CSFs Teacher Attitude and Delivery Method, which require more of a qualitative measurement. As proposed by Howard et al. (1985) that teacher effectiveness could be measured through student ratings, which is an effective evaluation method for this purpose.

As explained before, the data need of Capisci is retrieved and generated from pupil administration suite used in the school, and only necessary information is included in Capisci data model. Therefore, there is other available information in Magister relevant to this research and not yet listed here. Capisci deals mainly with quantitative data, while other descriptive data are not relevant for its data model. However, this kind of data is suitable for the generated framework and could be used to measure the identified CSF. One example is the course description which contains information about the relevant book and learning source. This data is relevant to measure the CSF Curriculum Organization, through the KPI teaching material.

Table 10 - Correlation between Framework and Data Availability

Component	KPI	Data		Description
		Available	Not Available	
Teacher	Teacher's education and training	Teacher (personnel) qualifications		Personnel qualifications show the education history record of teachers. It also gives information about the profiling of teachers based on their teaching degrees.
	Teacher holds a diploma aligned with the subject they teach	- Teacher (personnel) qualifications - Association between personnel, group and course		Comparing between personnel qualifications and group and course record that they teach to determine if the subject they teach is aligned with their education history.
	Teacher's teaching expertise	Teacher (personnel) qualifications		Personnel qualification shows the teaching history and other related work experience of a teacher.
	Teachers are involved in continuous learning		- Teacher's conference log - Financial allocation record	These data could show how much is invested in assuring that teachers are involved in continuous learning.
	Highly motivated teachers	- Teacher's absence frequency - Teacher's absence duration	- Teacher survey - Student survey	Combining information gathered from teacher's absence frequency and duration, could give an insight on the attitude of teachers. Further, survey could give good justification of the information.
	Teachers have the ability to understand student's need		- Teacher survey - Student survey	Getting student's opinion on how teacher perform could measure how much teacher could understand their students. Further, peer evaluation also adds value to this information.
	Teachers have the ability to encourage and motivate student	- Student's progress in a course - Student's absence record	Student survey	Student survey shows how student feel about their teacher. This combined with student's progress report and their absence record give insight to how much teachers encourage them.
	Teachers are emotionally involved with students		- Student survey - Teacher's performance review (from management)	Combining teacher's performance review by management with student survey give an overview of how much teacher engage themselves emotionally with their students.
Curriculum	School curriculum meets government standard	- Scheduled contact hours - Actual contact hours	- Management review - Teacher survey (peer review) - External assessment	Qualitative measurement measure curriculum design best. Combination of external assessment result, management review, and discussion between teachers from the same subject provide this information.

Component	KPI	Data		Description
		Available	Not Available	
	Teaching materials are up to date		- External assessment - Teacher survey - Course description	Course description gives information about the material used in teaching, external assessment and teacher survey confirms whether or not these materials are relevant and up to date.
	Curriculum should contain primary knowledge	- Scheduled contact hours - Exam components	- External assessment - Teacher survey - Management survey	Scheduled syllabus and exam components give information about the subjects that will be taught, and assessment from external assessor, teacher, and management evaluates the validity of this curriculum.
	Curriculum are properly designed and planned	- Scheduled contact hours	- Teacher survey - Course description	Teacher survey and peer learning gives confirmation about the correctness and completeness of the scheduled courses.
	Usage of effective presentation method		- External assessment - Student survey - Student quiz result (end of contact hours) - Course planning	Course planning gives information about the method used for different material, which is then evaluated through external assessment and student survey. Furthermore, quiz result shows how much students understand the given material, which implicates the effectiveness of how teacher presents it.
	Actively involving student into the process of pursuing knowledge	- Student test (assignment) result	- External assessment - Teacher survey - Course planning	Course planning explains the nature of the course, i.e. assignment that requires independent study and decision making, which are reviewed by external assessor and through peer review. Student assignment of the relevant task confirms how involved students are.
	Pay attention to the logical structure of teaching material		- Course description - Course planning - External assessment - Teacher survey - Student survey - Yearly review	Course description and planning give overview of how the teaching material is built, which is validated through external assessment, teacher and student survey, and yearly peer review.
	Usage of methods that improve students' communication skill and team-working	- Student test results	- Course description - External assessment	Course description provides information about the nature of the course, i.e. teaching method type, which is validated by external assessor. Student test result show how student cope with the method.

Component	KPI	Data		Description
		Available	Not Available	
Organization	Sufficient space and available classroom	- Course schedule - Student enrolled in a course - Classroom list	- Classroom occupational rate - Classroom size information	- Information about student listed in a course and which room a course will be conducted in, show the space each student will have during course. - Classroom occupational rate show the availability of classroom, in case of unscheduled class splitting (e.g. practicum that requires small groups)
	Reasonable teacher to student ratio	- Teacher record (number of) - Student record (number of) - Association between personnel, group, and course		List of student, teacher, and course planning shows how many students a teacher would handle in one course.
	School facilities and building are of good quality	School general information	School maintenance record	Record of maintenance work and routine check on school building gives an overview of the condition of the school.
	Availability of guidelines for students	- Personnel qualifications	- School guide - Student survey	Information of qualified person and availability of school guide for students in case of problem are confirmed through student survey.
	Attention given by school to students in accordance to their socio-economic status	- Number of students needing extra assistance - Student record		School profiling based on the number of students needing assistance show how school should allocate the extra funding they receive.
	Quality management policy regarding Human Resource of the school		- External assessment - School regulation - Teacher survey - Student survey	Assessments and survey show the environment of the school, and makes sure that school regulations create a safe environment for teaching and learning activities.
	Clear evaluation of students' development progress	- Final exam components - Student progress report (CITO test score)	- External assessment - Curriculum and academic calendar planning	External assessors assure that the development of students is well planned and measured.
	Well recognized school and reputation		- School position in external assessment rank (e.g. Elsevier's de beste scholen) - Awards received by school (e.g. Excellenet Scholen)	School awards and appraisal give a general view of how a school is perceived by external parties.
Student	The initial level of student's knowledge meets the school's entrance requirement	- CITO score - Advised school type to student (from primary education)		End of primary education CITO score and advised school type compared to required level of a specific school type, gives an overview of compatibility

Component	KPI	Data		Description
		Available	Not Available	
		- Study requirement		between student knowledge and requirements.
	High pass rate of student in each school level without having to re-sit a certain level	- Student enrollment information - Extra time student require to complete education - Association between student and course - Student progress report		Student result record shows how students are progressing with their studies.
	Students shows retention and persistence in their performance	- CITO score - Exam result (school exam, central exam) - Association between student and course - Student progress report		Steady or increasing results of student exams show that students are performing in an expected level.
	Students are able to continue to the next level after finishing their education	- Exam result - Association between student and course - Final exam components	Requirements of the following education	Student's final exam score shows in what level they are, and whether it is sufficient for continuing to the following education.

7.4. Dashboard Mockup

Mockup of the dashboard is created to give an idea of how the dashboard could look like, as shown in Figures 17 and 18. Each figure presented here represents one CSF, where Figure 17 is a dashboard for the CSF 'Teacher Competence' and Figure 18 is for the CSF 'Student Achievement'. Each CSF is measured by a combination of data which will give an insight about the quality of that CSF. Data are presented with a comparison of last year's result as the benchmark. Further, a plus (+) minus (-) indicator concludes each component measured so user could have a quick look of the overall result and able to identify and prioritize the components to focus on.

In the dashboard for 'Teacher Competence' shown in Figure 17, the component 'Degree of Competence' shows the percentage of teachers acquiring the different qualifications. The sum of all qualifications will equal to 100%. Meanwhile 'Investment in Teacher Learning' shows percentage of teachers in the school that already fulfills each category. Therefore it is not relevant to add up the percentages in this component.

	This Year	Previous Year	Objective	Satisfaction
Degree of Competence			To have more teacher closer to the highest qualification (i.e., 1st degree teacher)	
1st degree Teacher	30%	26%		
2nd degree Teacher	37%	32%		
Under Qualified Teacher	26%	29%		
Unqualified Teacher	7%	13%		
Investment in Teacher Learning (percentage of:)			Having teacher involved in continuous learning, from external activities such as seminars and also from internal discussions with other teachers	
Teacher going to seminars per year	63%	60%		
Financial allocation for teacher seminar	5%	5%		
Teacher conducting:				
Quarterly peer evaluation per course	76%	71%		
Quarterly peer evaluation per group	68%	68%		
Quarterly peer evaluation per study	84%	77%		

Figure 17 - Dashboard Mockup: Teacher Competence

	This Year	Previous Year	Objective	Satisfaction
New Students CITO Score			Percentage of new students going to a school level that matches their qualifications are high	
>5% lower than requirement	0	0		
Match requirement (±5%)	89%	87%		
>5% higher than requirement	11%	13%		
New Students Advice				
Advised lower level	0	0		
According to advice	94%	90%		
Advised higher level	6%	10%		
CITO Score Average			CITO scores are at least on the same level as previous year, or higher	
Dutch Reading Skills	220	230		
Dutch Vocabulary	235	240		
English Vocabulary	255	255		
Math	235	245		
School Exam Average			Exam scores are at least on the same level as previous year, or higher	
Math	8.4	8.2		
Dutch	8.0	7.8		
English	8.0	8.0		
Student Continuation				
Student going through next grade	95%	86%	Percentage of students going through to next grade are high and increase yearly	
Student repeating a year	5%	14%		
Final year student passing	96%	88%	Percentage of final year students finishing their education are high and increase yearly	
Final year student failing	4%	12%		

Figure 18 - Dashboard Mockup: Student Component

Chapter 8 – Conclusion

8.1. Conclusion and Discussion

This research tries to answer the research question and sub-questions described in Chapter 1.3 through literature review, initial expert interview, data analysis, and survey. In order to answer the main research question, five sub-questions contributed as a building block of this research. Each sub-question will be answered in order to answer the main research question.

SQ1: What is the definition of quality in the context of education?

From literature study, it was found that there is no one strict definition of quality in the context of education. Different research works have different views on how to see quality in education sector. It varies based on the level of education, the mission of each school, and the focus of each research work. A well-known perspective on education quality (i.e., education quality dimension) is used as a first step on defining quality. Five different dimensions of education quality are identified (Harvey & Green, 1993) which are not mutually exclusive from each other, namely:

- Quality as exceptional
- Quality as perfection or consistency
- Quality as fitness for purpose
- Quality as value for money
- Quality as transformative

Based on these dimensions, a definition of education quality in Dutch secondary school was derived through expert interview. From interviews with 7 experts, it was found that the most suitable way to define education quality in Dutch secondary schools is quality as transformation through added value.

SQ2: What stakeholders and components should be included in measuring quality in education?

Firstly, a literature study was conducted in order to answer this sub-question followed by expert interview. Based on literature study, variety of stakeholders was identified as different research work includes different view of education quality which affects the stakeholder choice. This includes student, teacher, non-teaching staff, society, government, future employer, parents, and school management. Expert interview follows this step in order to identify stakeholders relevant to assuring education quality in Dutch Secondary Schools. The result of literature study was brought for discussion through a semi-structured interview. From interview conducted, it was

discovered that the most important stakeholders that should be included in the context of Dutch secondary school are student, teacher, school management, and external stakeholders.

Furthermore, identification of components to include in measuring education quality was done through expert interview. Based on the result of 7 expert interviews, there are four components that should be assessed separately and be included in measuring education quality. These components are curriculum, teacher, student, and circumstances where the education process is conducted. This last component is translated into school as an organization, which is where the education process happens.

SQ3: What data are currently available and what are still needed to measure education quality?

In order to answer this sub-question, a feasibility analysis was performed in the environment of Capisci, an information system developed by Datapas BV where this research was conducted. This allows investigation of the currently available data that could be used to measure each component. From this process, it was found that data currently available are mostly quantitative raw data. This includes student exam score, student and teacher absence data, parent information data, and student's yearly aptitude test result. Nevertheless, extensive and historical data is available for each specific school.

Data that is still necessary for quality education involves mostly qualitative data which includes student survey on teacher performance, student satisfaction survey, teacher satisfaction survey, assessment on teacher and school performance, and information about teacher qualifications. For more detail regarding this matter, a comprehensive table is presented in Chapter 6.3.

SQ4: To what extent can business intelligence be employed in assuring education quality?

In order to put the data to use, a business intelligence framework is chosen and found to be suitable for the purpose. The business intelligence framework which consists of 5 layers was employed with a top down approach starting with vision, strategy, critical success factors, key performance indicators, and dashboard/scorecard. A set of CSF was generated from literature review, and linked to the answers derived from SQ2. A combination of literature review and expert validation was employed to create a KPI list which is then validated through survey conducted to secondary school directors in the Netherlands.

By employing the business intelligence framework, the vision is translated into a dashboard of measureable components. Data analysis was conducted to the current data model of Capisci, and linked to validated framework to see what data could be used to measure each KPI. Based on these findings, a dashboard mockup is created which shows the information representation that is used by people involved in teaching process and school decision makers.

By answering these sub-questions, the main research question of "**how can business intelligence process be employed to assess the quality of education in secondary schools in the Netherlands?**" could be answered. Business intelligence framework provides the guideline as to what layers should be made available throughout this research. In implementing these layers into practice, business intelligence process steps are followed and associated to each layer of the framework. By doing so, this research is able to translate vision of education quality into practical visual tool – a dashboard – to help school management in monitoring their school quality and direct their decision making to achieve good quality education.

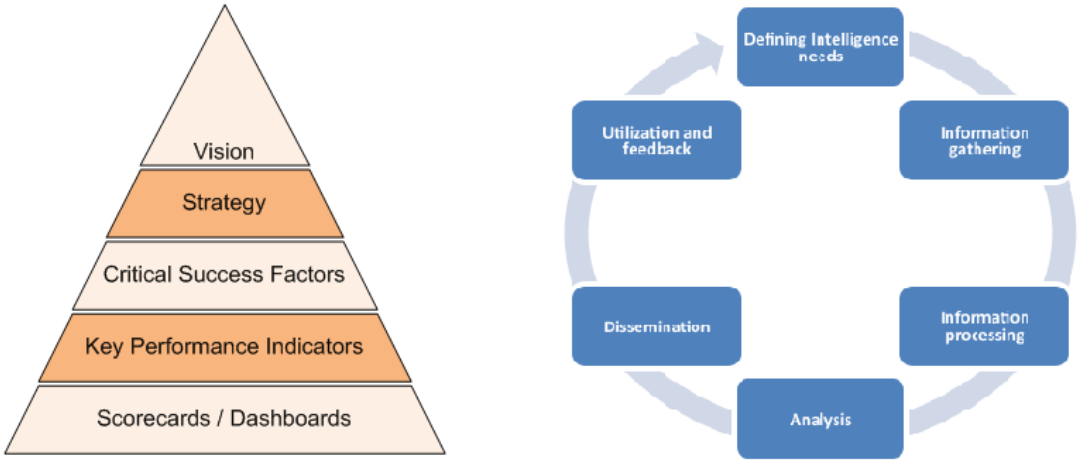

Figure 19 - Revisited, BI Framework and BI Process Model

The process steps underwent in this research yields a framework for education quality assessment. As this framework is far from perfection, it could be a starting point in developing a measurement to assure education quality that is general in nature to be implemented in different level of education and different setting of education scheme.

Looking back to the high-level business intelligence architecture by Turban et al. (2010) explained in Chapter 4.4., this research is able to identify the components introduced there. In order to qualify as a business intelligence system, following correlation between research finding and Capisci system is made:

1. Data warehouse environment
   "A data warehouse is a subject-oriented, integrated, time-variant, nonvolatile collection of data in support of management's decision-making process" (Turban et al., 2010). As explained in Chapter 6.1., Capisci fetches required data from pupil administration suites such as Magister and SOM. In building the data warehouse, thorough organizing, and summarizing are required so that all data stored are standardized.

2. Business Analytics Environment
   This component needs to be further developed to provide user with analysis tools and technique and allow user to manipulate data. Tools and technique for data manipulation in a business intelligence system fall into two major categories, namely reports and queries and data mining.
3. Performance and Strategy
   Generated education quality model is implemented here as a basis to monitor education quality performance, and direct management in making decision. This is important to integrate as BI's major objective is to provide decision makers (i.e. school director) with valuable insights that enable them to make more informed and better decision.
4. User Interface
   A dashboard mockup has been developed to give an overview of how user could get an insight on overall information, which will help in decision making.

8.2. Limitations and Further Research

It is very important to understand and communicate the limitations of the conducted research, so that the audience of this research could have complete understanding of the research and learn from the limitations. First of all, the qualitative nature of the interview raises a certain risk in creating the initial framework as it is possible that the experts have had a certain bias and subjectivity on the matter. Furthermore, some experts have been working in a different focus of education level which deviates from the secondary school.

Selection of literature review source in the topic of education quality is also tricky as not many research works have been found in the secondary school, and mostly focused on higher education or primary education. Furthermore, literatures used in this research are mainly a research work conducted in a different country with a different education system. Efforts have been made to increase the validity of this research by selection of Dutch literature which could capture the actual education system situation in the Netherlands.

Thirdly, the low number of respondent for the online survey may also jeopardize the validity of the framework. High workload of people in school limits the possibility of sending out the survey only to school directors and not the teacher themselves as well. Furthermore, due to time limitation the invitation was not sent out to all school directors, but only selected school which has good review. From the invites sent out only 14% response received, which may challenge the assumption that the population was represented.

Another important limitation of this research is the fact that quality in education is something that is very qualitative and requires a subjective opinion. With the research finding that the focus should be on teacher and how they connect with student, a measurement of student satisfaction is necessary. However, this kind of data is not yet available in the environment where this research

is conducted, and therefore it is difficult to link the research finding into an implementable information system. In order to be able to implement this framework another step is required before the implementation, which is to conduct student survey, peer review, or interviews to gather the needed information.

Another possibility for future research is to include other stakeholders in developing the framework, such as external stakeholders. This could include the parents, people from higher education, people from labor market, and the students themselves. Introducing the government's perspective was an idealistic goal to add in the framework creation process, be it the Ministry of Education or *Onderwijs Inspectie*, as they play a very important role in setting the rule in assuring education quality. However, it was found to be very difficult to be in contact with both parties.

In assessing the feasibility of education quality model framework implementation, some difficulties were also encountered. The lack of availability of a well-documented system data model, makes it time consuming in analyzing and understanding the system model. Therefore, it is possible that some definitions and relations are translated differently from the way it is. Different attempts underwent to minimize chances that error occurred through communication and discussion with system developer and designer.

Last but not least, a personal limitation comes to play, that the researcher encounters when conducting this research. Being a foreigner who is not familiar with the Dutch education system and does not speak the language, it took time to fully understand how the education is structured in the Netherlands. It was also difficult to make contact with the respondents, especially for survey purpose. Along the way, there are still some terms encountered here and there that are not easily translated and understood.

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Appendix A – Survey Result Analysis

Table 11 - CSF Average Score from Theoretical Group Respondents

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Average score for Teacher Competence CSF	17	3.25	4.50	4.0441	.36695
Average score for Teacher Attitude CSF	17	3.75	5.00	4.3971	.40561
Average score for Curriculum Organization CSF	17	2.50	5.00	3.6618	.76517
Average score for Delivery Method CSF	17	3.00	5.00	4.0882	.55861
Average score for School Infrastructure CSF	17	2.25	4.75	3.6176	.66213
Average score for Organizational Support CSF	17	2.50	4.75	3.6912	.55572
Average score for Student Achievement CSF	17	3.50	4.50	4.0441	.33349
Valid N (listwise)	17				

a. Is the school in theoretical or practical group = Theoretical (HAVO/VWO)

Table 12 - CSF Average Score from Practical Group Respondents

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
Average score for Teacher Competence CSF	18	1.75	5.00	3.9583	.72887
Average score for Teacher Attitude CSF	18	1.00	5.00	4.3194	.91477
Average score for Curriculum Organization CSF	18	2.25	5.00	3.9306	.54776
Average score for Delivery Method CSF	18	1.50	5.00	4.1528	.78187
Average score for School Infrastructure CSF	18	2.00	5.00	4.0139	.69912
Average score for Organizational Support CSF	18	1.75	5.00	3.7361	.76443
Average score for Student Achievement CSF	18	1.75	5.00	3.7778	.66911
Valid N (listwise)	18				

a. Is the school in theoretical or practical group = Practical (VMBO)

Appendix B – Box Plot for CSF based on School Type

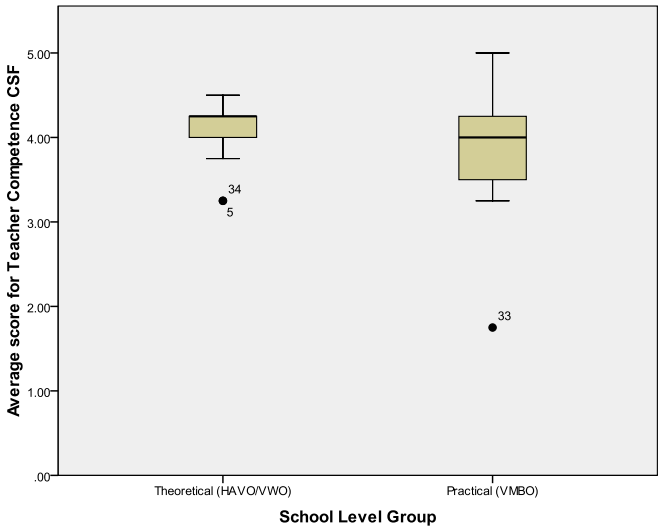

Figure 20 - Box Plot for Teacher Competence

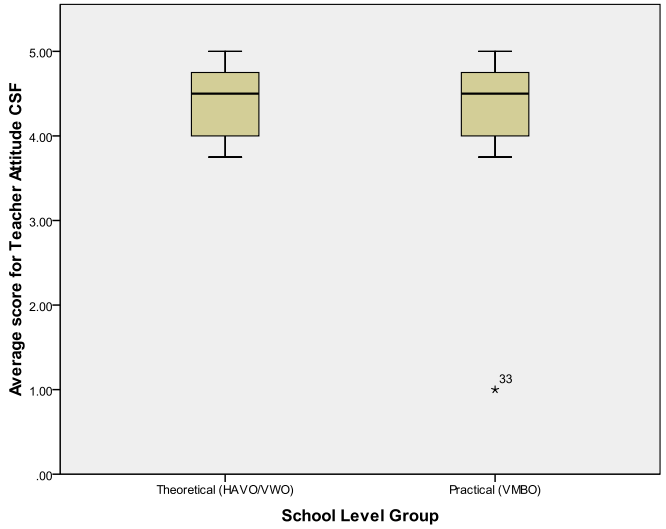

Figure 21 - Box Plot for Teacher Attitude

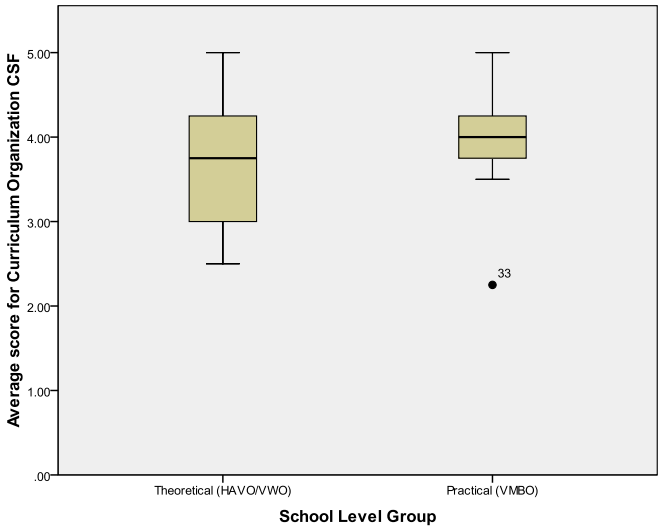

Figure 22 - Box Plot for Curriculum Organization

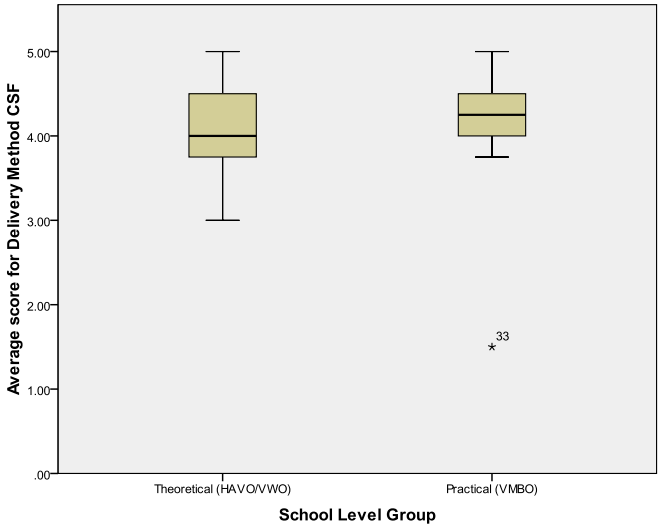

Figure 23 - Box Plot for Delivery Method

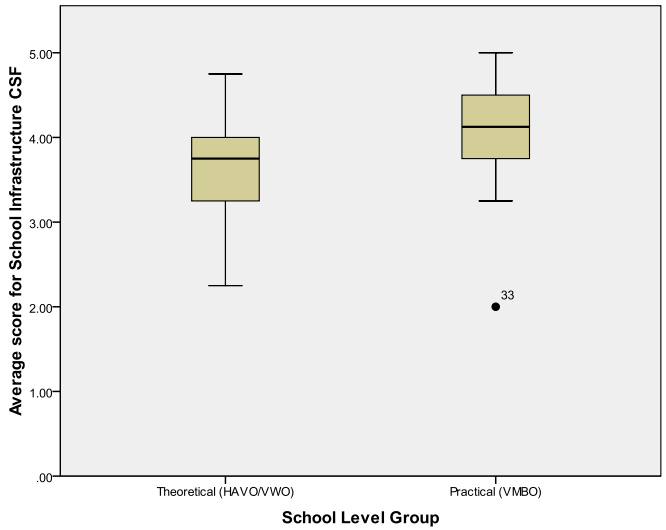

Figure 24 - Box Plot for School Infrastructure

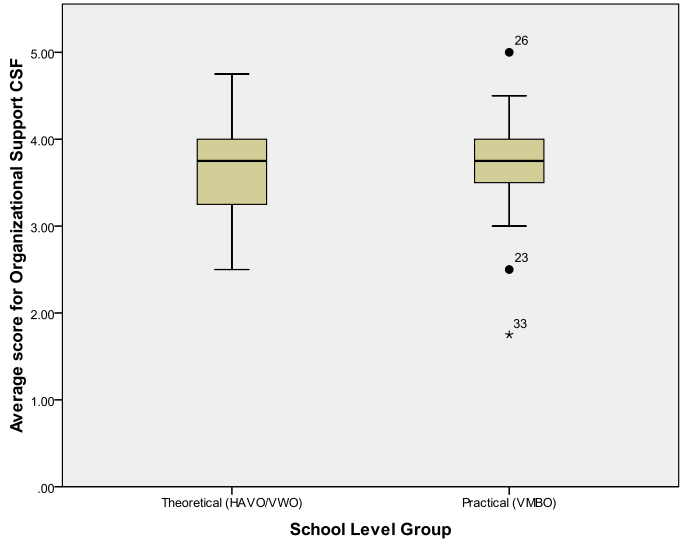

Figure 25 - Box Plot for Organizational Support

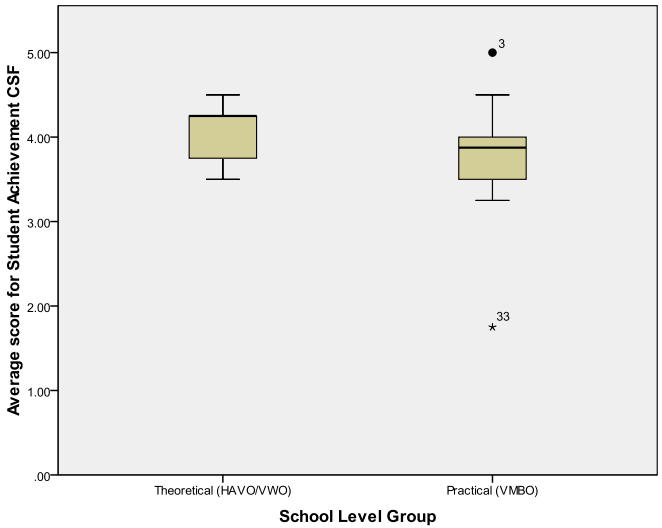

Figure 26 - Box Plot for Student Achievement

Appendix C – Capisci Table List

List of tables used in Capisci data model is as follows:

hrnnaam	: GENERAL TABLE	
lgf	: financial-wise special conditions	
schoolsoort	: education level	
sis_aanm	: registration table	(aanm = aanmelden)
sis_abty	: student's absence	
sis_advi	: definition of advices from primary	
sis_bgem	: *gemeente*	(gem = gemeente)
sis_bgrp	: definition of general lesson group / class	(grp = groep)
sis_bins	: definition of result table (exam result related to education)	(ins = instellingen)
sis_blfa	: identification of student's school year and type	(lfa = leerfase)
sis_blok	: general school information (data, location)	(lok = lokatie)
sis_blpe	: school year table	
sis_bnat	: definition of nationality	(nat = nationaliteit)
sis_brel	: general school relation (all entities related to school)	(rel = relatie)
sis_bvak	: definition of courses	(vak)
sis_bvrt	: definition of reasons for leaving school	(vrt = vertrek reden)
sis_bvty	: GENERAL TABLE	
sis_cijf	: all exam result scores	
sis_ckol	: scores column definition	(ckol = cijfers kolom)
sis_debi	: debtor financial module	
sis_ibgm	: connection to BRON	
sis_leer	: student table	
sis_lvak	: connector between student and course	(lvak = leerling vak)
sis_oudr	: parents table	
sis_pers	: personnel table	
sis_pgvk	: connector between personnel group and course	(pgvk = persoon groep vak)
sis_prof	: definition of profiles	
sis_rsch	: relation of school with other schools	(rsch = relatie school)
sis_rtyp	: definition of relation	(rtyp = relatie type)
sis_stud	: definition of studies	
sis_svak	: study courses to take	(svak = studie vak)

Appendix D – Capisci Table Definition

Currently, the available data for Capisci system could be identified through its database diagram. However, the database diagram comes with a limitation that it does not display the relation of tables properly. For the purpose of this research and ease of use, the mentioned information is summarized in the following Table.

Table 13 - Capisci Table Definition

Table name	Definition	Derived Data
lgf	This table holds the definition of different types of problems student has (indication) which require special attention from teacher in learning process	- Students with special attention needs - Type of indications
Schoolsoort	This table holds the definition of different education level available	School type
sis_aanm	This table holds the information about the registered student for each school year	Aggregate of the different tables related to registered students and their education
sis_abty	This table holds the information about student's absence list, including whether it is an allowed absence or not	Student absence record
sis_advi	This table holds the definition of the suggestion received by student from their primary school with regards to school type	Advice received based on primary education results: HAVO, VWO, and four different types of VMBO. Students may get more than one advice
sis_bgem	This table holds the definition of the municipality	Municipality in the Netherlands
sis_bgrp	This table holds the definition of the lesson group (i.e. class)	- Group general information - Responsible mentor - Related study profile - Group period
sis_bins	This table holds the definition of the education result table	- Result per school year - Education profile - School type followed - Duration of education
sis_blfa	This table holds the information about which phase the student currently is at	- Current school type - Current school year/level
sis_blok	This table holds general information about the school	- School name - School address - Bank account - School organization structure
sis_blpe	This table holds the information about a certain school year	- School period - Start and end of school year
sis_bnat	This table holds the definition of nationality	Nationality
sis_brel	This table holds the information about	

Table name	Definition	Derived Data
	relations the school have with other entities	
sis_bvak	This table holds the definition of available courses	- Course name and code - Education type - Duration - Planned contact hours - Classroom type
sis_bvrt	This table holds the definitions of reasons why students leave school	Different reasons student leave school
sis_cijf	This table holds all data of evaluation result (exam, assignment)	Assessment scores
sis_ckol	This table holds the definitions of score columns	Construct for the score table
sis_debi	This table holds the information about the debtor financial module of the school (e.g. tuition fee deduction)	Account related information
sis_ibgm	This table holds the related information with BRON	- Student general information - Education registration information
sis_leer	This table holds the general information about student identity and qualification from primary education	- Student general information - End of primary school CITO score - Advised school type from primary education
sis_lvak	This table manages the relation between students and courses	- Student information - Associated course (primary and elective) - Start and end date - Extra time required to complete education - Diploma
sis_oudr	This table holds the information about parent identity	General information about parent
sis_pers	This table holds the information about personnel identity	- Personnel general information - Personnel salary - Personnel qualifications
sis_pgvk	This table manages the relation between personnel (i.e. teacher), education group, and course	- Course information - Course period - Course belongs to which group - Course minute - Personnel relevant to the course and group
sis_prof	This table holds the definition of student's profiling	- Studies related to the profile - Study results - Final exam components
sis_rsch	This table holds the information about school relation with other schools	- School general information - Type of relation
sis_rtyp	This table holds the definition of school relations with external entity	Type of relations

Table name	Definition	Derived Data
sis_stud	This table holds the definition of a certain level of the education process (e.g. HAVO upper year)	- Study general information - School year - Study duration - Personnel responsible for the study - Study requirement - Education type - Related profile
sis_svak	This table holds the relation between study type and courses related to it	Possible courses to follow