

# Quantifying Education Quality in Secondary Schools

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## **Abstract**

This research assesses the important factors in assuring education quality in secondary schools by using a business intelligence approach. A Business intelligence framework is created by employing a business intelligence process to identify the stakeholders and components relevant to education quality. The resulting Education Quality Indicator (EQI) framework consists of seven Critical Success Factors and is measured through twenty-eight Key Performance Indicators. The EQI framework is evaluated through expert interviews and a survey, and demonstrates that the most important factor in assuring education quality is a teacher's ability to communicate with students. Finally, 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

## **1. INTRODUCTION**

Even though many research works have been conducted to assess quality in education, there is no standard on how to measure quality of education (Becket & Brookes, 2005). In the Netherlands, there exists a protocol for measuring education quality in schools, which is conducted by the Education Inspectorate by investigating various aspects that affect the education process. However, this inspection is conducted on a yearly basis. This means that the measurement of a school's strategy can only be done on a yearly basis, which is not ideal for schools as they cannot see whether their operational activities are conducted towards the right direction. Our research aims to provide a 'traffic light' which warns when school activities are not going toward the desired goal. This is done by employing a business intelligence framework and process model to help schools direct their policy. We aim to answer the following research question: 'how can a business intelligence process be developed to assess the quality of education in secondary schools?'

## **2. RESEARCH METHODS**

This research follows the Design Science research model by Hevner, March, Park, & Ram (2004) to create a framework that encompasses all the important components and stakeholders of the education process. As a first step of this research, a literature study is conducted in both the topic of education quality and business intelligence. In addition, we review the Dutch education system as this will be the exemplary environment for our research. Next, a semi-structured interview method (Longhurst, 2010; DiCicco & Crabtree, 2006) is employed to gather data from experts in the field of education. 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 one founder of an education quality assessment organization. After conducting interviews, we develop our initial framework, which is then validated through a questionnaire survey to secondary school directors in the Netherlands. The questionnaires handed out in this research are online and aimed for school directors of the different level of secondary schools in the Netherlands.

### 3. THEORY

#### 3.1. THE DUTCH EDUCATION SYSTEM

In the Netherlands, the education system is divided into three parts: primary, secondary, and tertiary education, as shown in Figure 1 (Scheerens, Luyten, & Ravens, 2011; Dutch Eurydice Unit, 2007). The focus of this research is on secondary education, which starts at the age of twelve. 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).

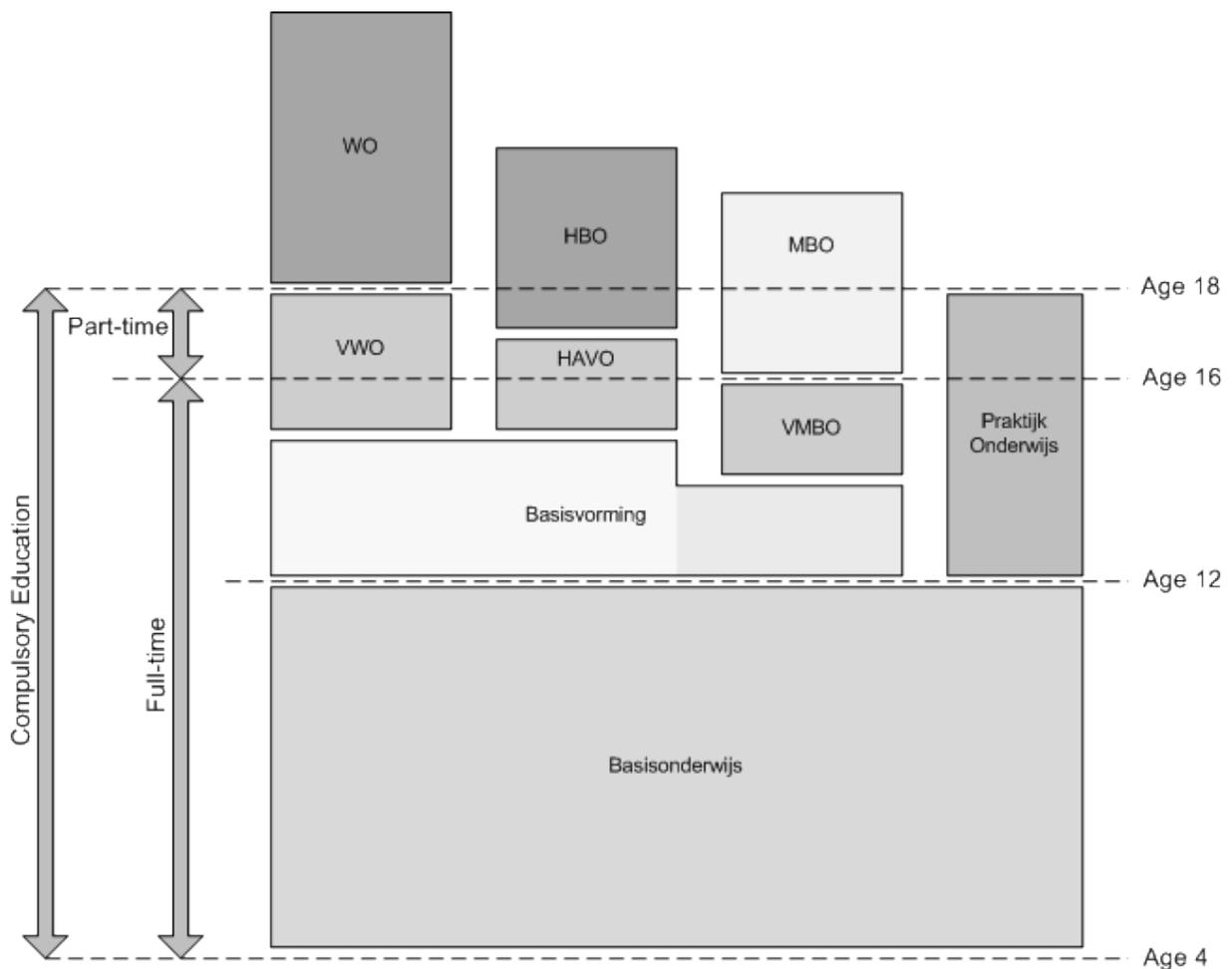


Figure 1 – The Dutch education system, based on Scheerens et al. (2011).

VMBO (*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 whose 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 students for vocational training in the higher level of education.

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 a duration of five years. After finishing education in HAVO, students may continue to professional higher education (HBO), also known as the polytechnic level.

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 the 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.

In both HAVO and VWO, 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. 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. This research uses the definition and differentiation of education quality by Harvey and Green (1993), which groups the concept of quality 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 processes and sets specifications 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 fitness itself is 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 whether other stakeholders (e.g. academic staff) should 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 encapsulate 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.

### 3.3. BUSINESS INTELLIGENCE

#### 3.3.1. Business Intelligence Definition

Many research works propose different definitions of business intelligence (Negash & Gray, 2008; Power, 2007; Lönnqvist and Pirttimäki, 2006; Ranjan, 2009; Gangadharan & Swami, 2004; Watson and Wixom, 2007). 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 viewpoints (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. In contrast, the technical approach considers business intelligence as a set of tools that support the process in the managerial approach, focusing more on the technologies, algorithms, and tools, instead of on the process.

From the various definitions and different views there is one underlying common concept, which is the purpose of business intelligence: to facilitate management 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 definitions, namely the 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. We define Business intelligence as

“the process and methods 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, Linders, Raja, Reboullet, & Ommerborn, 2009; Lönnqvist & Pirttimäki, 2006; Negash, 2004).

### 3.3.2. Business Intelligence Framework

Wasmann and Spruit (2012) followed Roekel et al. (2009) in proposing 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 dashboards. 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 and dashboards, among others. Business rules may be enforced by logic in the operational systems but may also be applied within the business intelligence environment.



Figure 2 - BI Framework by Wasmann and Spruit (2012).

### 3.3.3. Business Intelligence Process

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. 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 Salonen & Pirttimäki (2005) as shown in Figure 3. The cyclical model starts with planning based on corporate needs, 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; 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, and will then be utilized by decision-maker.

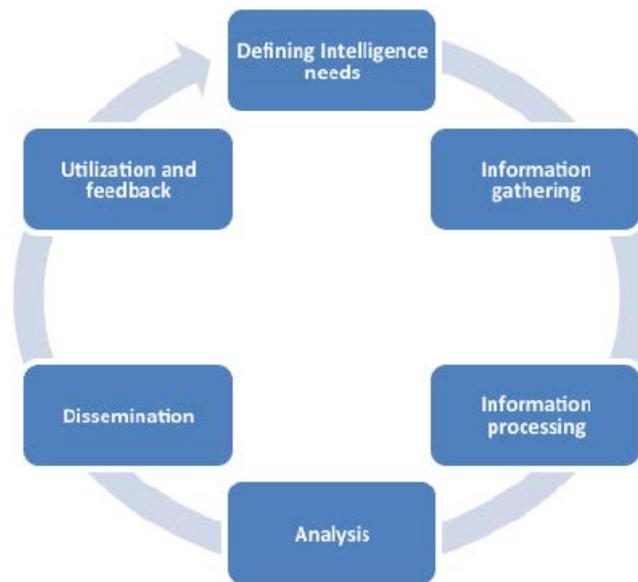


Figure 3 - BI Process by Salonen & Pirttimäki (2005).

### 3.3.4. 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.

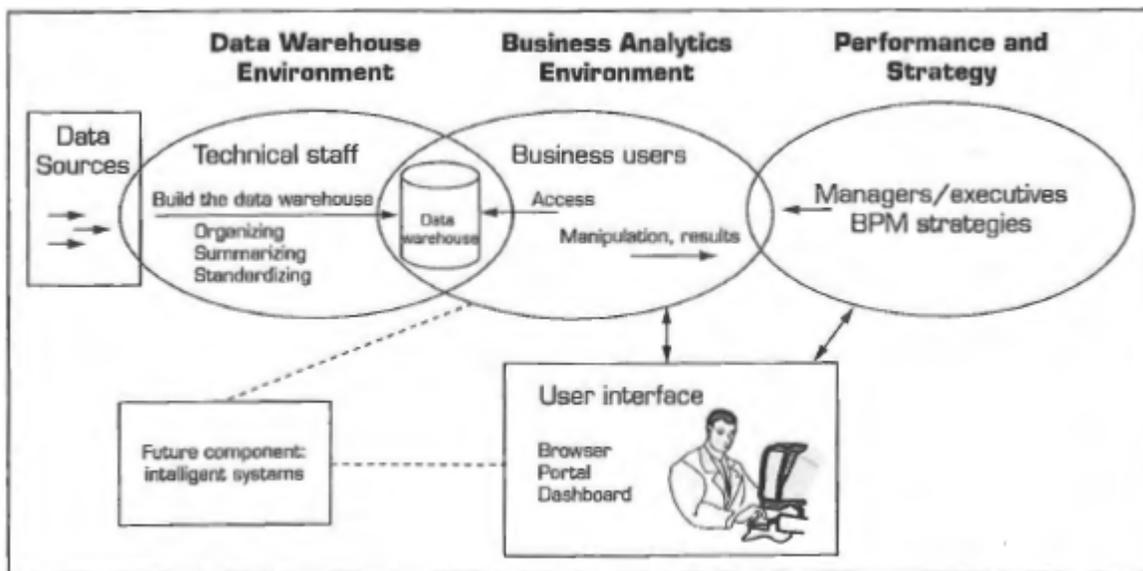


Figure 4 - BI Architecture by Turban et al. (2010).

### 3.4. IMPLEMENTATION IN THIS RESEARCH

This research follows the six step business intelligence process model by Salonen & Pirttimäki (Figure 3), in putting into practice and translating the business intelligence framework (Figure 2). Correlation between the process model and the layers of business intelligence framework is summarized in the following Table 1:

Table 1 - Our research operationalization which connects the BI framework and BI 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 quality based on best practice	CSF, KPI	Literature study, Expert interview, Questionnaire	Education quality framework
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			

## 4. RESULTS

### 4.1. 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 was 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. The overview of interviewees involved is summarized in Table 2.

There were no strict guidelines and lists of questions for the interviews, but they did cover a pre-determined list of topics. Because they were initial interviews, the topics prepared included:

1. Understanding how education quality could be best described in the field of secondary education.
2. Discovering the important stakeholders that should be taken into consideration in measuring education quality.

3. The important components in education process that affect quality of education.

At the end of each interview, interviewees were left with a long list of indicators about education quality which we gathered from previous research works on education quality. Interviewees were asked to give a rating and choose what indicators they consider important and relevant in the context of secondary education in the Netherlands. The results have been used in building the framework.

**Table 2 – Overview of Interviewees**

<b>Expert</b>	<b>Description</b>
1	Senior policy advisor in a secondary school group in the Netherlands, is responsible for education quality assurance
2	Senior policy advisor in a secondary school group in the Netherlands, is responsible for education quality assurance
3	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 services in the council of international schools, has been actively involved in setting up guidelines and conducting accreditation of secondary schools around the world
5	Co-founder of 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	Expert in performance management, co-creator of a well-known dashboard to measure education quality in primary schools which supports the PDCA cycle
7	Advisor in education governance board. Interviewee has a coaching and consultancy firm that helps school leaders monitor education quality through an educational scorecard (which is based on the balanced scorecard). Interviewee is the co-creator of a well-known dashboard to monitor education quality in primary school which supports the PDCA cycle

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

With regards to stakeholder selection, 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 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 as stakeholders that should be included in assuring education quality.

Furthermore, discussion about the education quality component ended with a conclusion that 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.

## 4.2. 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. 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 at the 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.

Table 3 shows a comparison and grouping of the characteristics based on previous research and education quality guidelines used by different organizations. Based on this characteristic grouping, critical success factors for this research are generated.

### 4.2.1. 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

**Table 3 - Education Quality Success Factor**

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	The curriculum intent and philosophy	Teaching and Learning	Teaching, learning	Teaching and Learning		Delivery Method
					Instruction Medium		
Content				Curriculum Design, Content, and Organization	Content and Delivery of Course Units		Curriculum 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 Placement	Exam Result	Student Achievement
				Assessment	Academic Performance		
					Assessments		

approach they see fit. Therefore, in assuring education quality in the Netherlands, curriculum organization plays a very important role. Aligned with the interview result, our 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.

#### 4.2.2. Delivery Method

As found from the interviews, the ability of the teacher to connect with a student is very crucial in assuring good education quality. 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 and QAA Guideline. As suggested by Horsburgh (1999), a student's learning experience is highly impacted by how teachers 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 aspects viewed relevant for this CSF include 'instruction medium' (Chua, 2004), the extent to which a course is offered in a proper sequence (Mergen, Grant, & Widrick, 2000), and 'effective presentation' (Owlia & Aspinwall, 1996). However, our 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).

#### 4.2.3. 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 the 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* (i.e. ‘excellent schools’). 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 to students with low-ability by allocating additional resources for those students, as it will help improve their performance (de Haan, 2012; Card & Payne, 2002).

#### 4.2.4. School Infrastructure

Tangibles also play an important role in having a smoothly conducted learning process. Student would be able to have a more optimal learning experience when there are sufficient facilities supporting the education process. This includes availability of classrooms, required equipment such as a computer and laboratory access, and also a clear guideline for students (UNESCO, 2004).

The condition of the school building itself has the effect on teaching and learning effectiveness. Comfortable classroom temperature and noise level are very important in 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).

#### 4.2.5. 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 includes creating an admission requirement and appropriate faculty qualifications to filter selection of students (Chua, 2004; Mergen et al., 2000).

#### 4.2.6. Teacher Attitude

Teachers are the heart of education, therefore it is very crucial for teachers to have a positive attitude. As discovered from interviews, teachers should be able to communicate and connect emotionally with students 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 students (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 interviews (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).

#### 4.2.7. Teacher Competence

As solicited from interviews, a 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 the competency of the teacher. Expert 3 explains that the teacher's qualification, in terms of the level of the teacher's previous education, is an important aspect to focus on to assure the quality of the teacher. This is also supported by literature 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 a teacher's competence include measures of academic ability, years of education, years of teaching experience, and 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, the teacher qualification system is already in use in secondary schools to differentiate their competence. The qualifications include 1<sup>st</sup> degree teacher, 2<sup>nd</sup> degree teacher, under qualified, and unqualified teacher. This differentiation is determined based on the education that they have received, with 1<sup>st</sup> degree teacher being the highest qualification.

#### 4.3. INITIAL FRAMEWORK

As explained in section 4.1., the interviewees were asked to give ratings on a list of indicators gathered from previous research work on education quality. The selection of research publications 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 were based on a 5-points Likert scale according to their importance, with 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, attached in Appendix A.

#### 4.4. VALIDATION OF FRAMEWORK

For the validation of framework, an online survey was conducted on secondary school directors through a questionnaire. In the questionnaire, respondents are provided with the CSF and KPI list from the initial framework. 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 KPIs 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 the KPI and CSF components in practice in assuring a good education quality.

## SURVEY RESPONDENTS

An invitation was sent out to 244 directors from all types of secondary schools. Schools were chosen based on their rank given by the so-called Elsevier rank of good schools, by focusing on schools that get a good review. In 2013 Elsevier published a rank of good quality secondary schools in the Netherlands, titled *Beste Scholen*, i.e. ‘best schools’. 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 were also two respondents who are a director of a so-called *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 are summarized in Table 4.

**Table 4 – Respondents of the online survey**

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

School Type Directed	Number of Students	Province	School Area
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

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 another KPI in the list and are a rephrasing of the same purpose. Therefore it is not necessary to add extra KPIs to the existing list, and it is considered complete.

#### 4.4.1. GENERAL RESPONSE ANALYSIS

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 5. 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. A 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 5 - General Response

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 5 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 interviews 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 CSFs listed are ‘Teacher Attitude’ and ‘Delivery Method’.

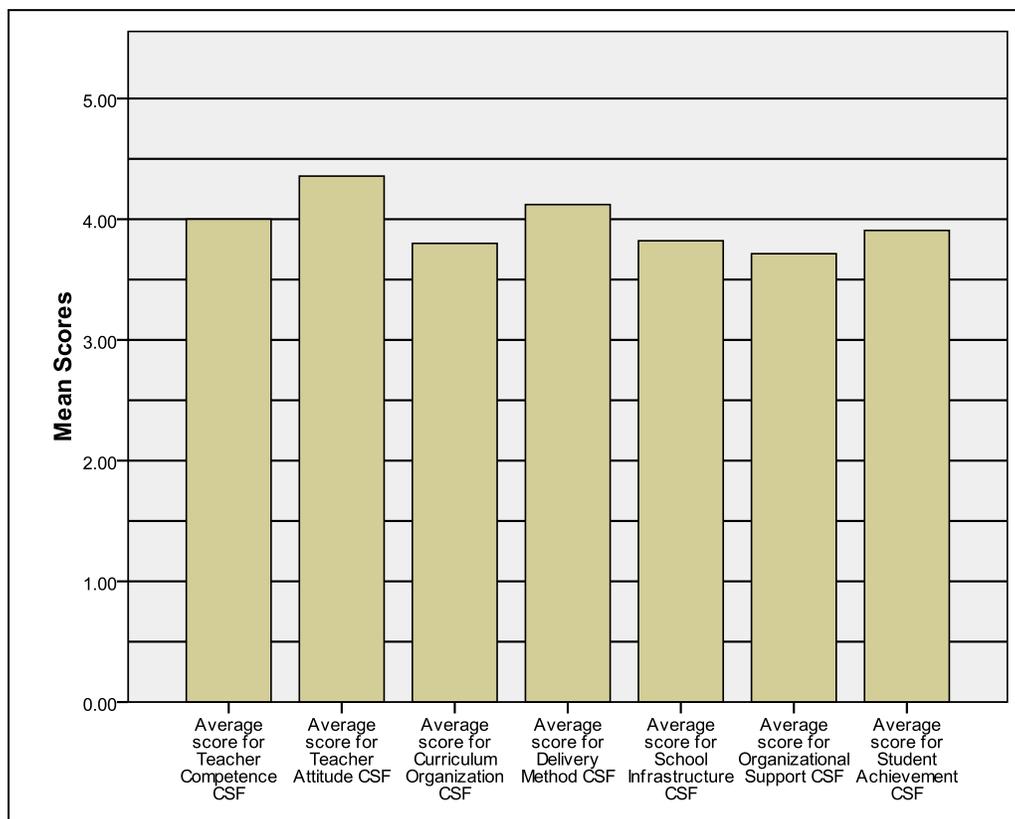


Figure 5 - General Response

#### 4.4.2. 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 6. 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.

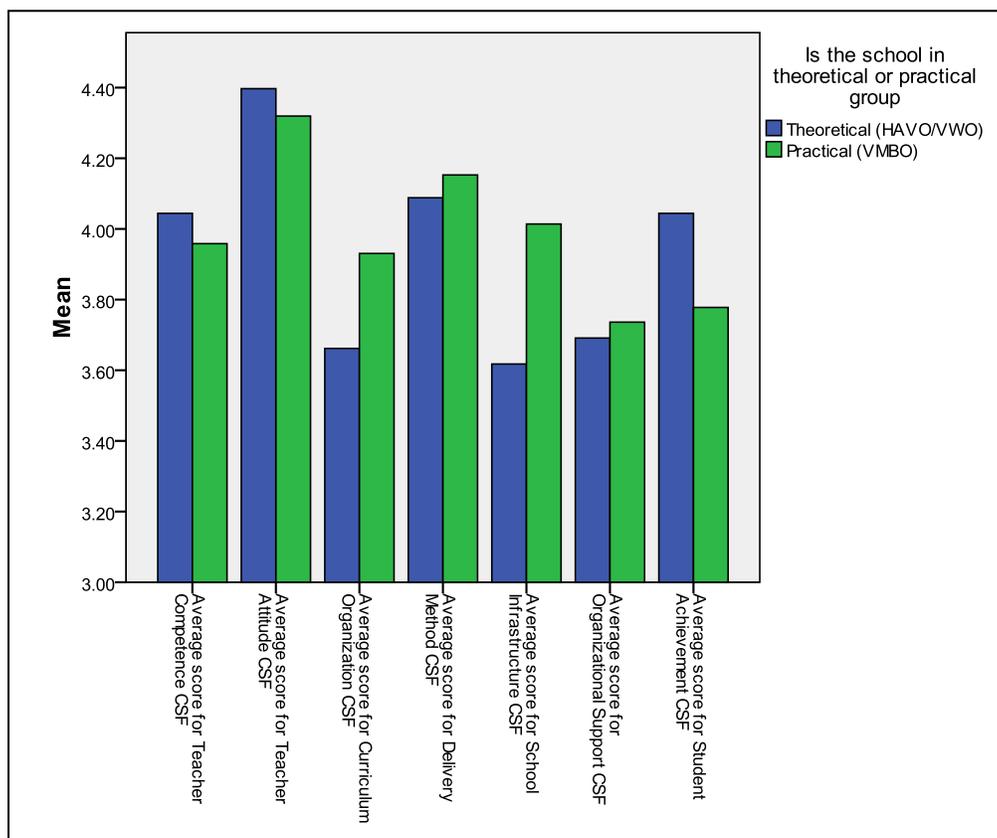


Figure 6 - School Type Analysis

	Theoretical Group Mean Score		Practical Group Mean Score
Average score for Teacher Attitude CSF	4.3971	Average score for Teacher Attitude CSF	4.3194
Average score for Delivery Method CSF	4.0882	Average score for Delivery Method CSF	4.1528
Average score for Student Achievement CSF	4.0441	Average score for School Infrastructure CSF	4.0139
Average score for Teacher Competence CSF	4.0441	Average score for Teacher Competence CSF	3.9583
Average score for Organizational Support CSF	3.6912	Average score for Curriculum Organization CSF	3.9306
Average score for Curriculum Organization CSF	3.6618	Average score for Student Achievement CSF	3.7778
Average score for School Infrastructure CSF	3.6176	Average score for Organizational Support CSF	3.7361

Figure 7 - Theoretical and Practical Comparison

A comparison of the average scores of the two groups is presented in Figure 7. It could be seen that for both groups the CSFs ‘Teacher Attitude’ and ‘Delivery Method’ are listed as the two most important CSFs. A difference is seen in the third CSF for the different groups, 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 a student’s practical skills which require good quality of the provided school facilities.

#### 4.4.3. ANALYSIS BASED ON A SCHOOL’S DEFINITION OF QUALITY

Our next analysis investigates the differences in score average based on how the respondent views quality in education. In the questionnaire, definitions of five different dimensions of education quality (Harvey & Green, 1993) as explained in Section 3.2, were 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 examples of the definition in this group include ‘Quality as equipment for life’, ‘Education allows a student to shape their future with knowledge and confidence’. Further, 8 respondents view ‘Quality as Exceptional’, 7 answer ‘Quality as fitness for purpose’, and 4 select ‘Quality as Perfection’.

The average score for each definition group is presented in Table 6, while Figure 8 gives an overview of the answers through a line graph. From the descriptive table, it could be seen that the two most important CSFs in all definitions are ‘Teacher Attitude’ and ‘Delivery Method’.

**Table 6 - Definition Quality Analysis**

	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

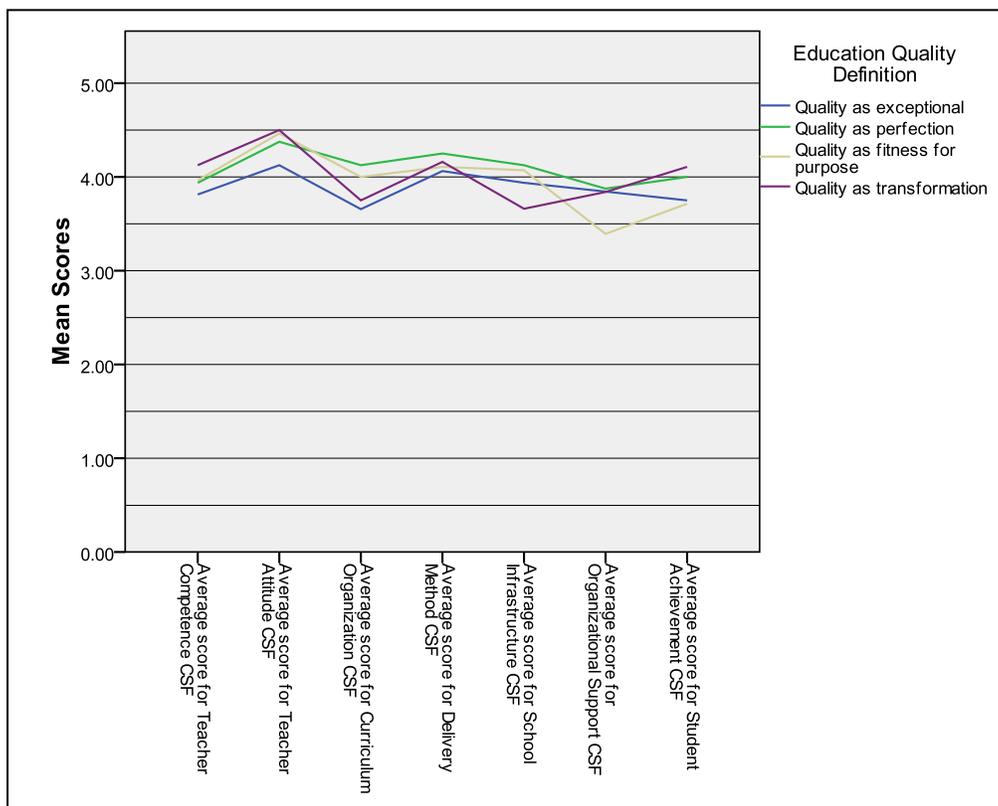


Figure 8 - Definition Quality Analysis

To summarize, we present the validated framework—the *Education Quality Indicator (EQI) Framework*—and its importance based on the different group analysis in Figure 9. CSF importance in the framework is presented in a gradient color scheme, ranging from orange to green. The ‘Less important’ scale is used relative to the other CSFs, because from our survey it is found that the average score of every CSF is bigger than 3.

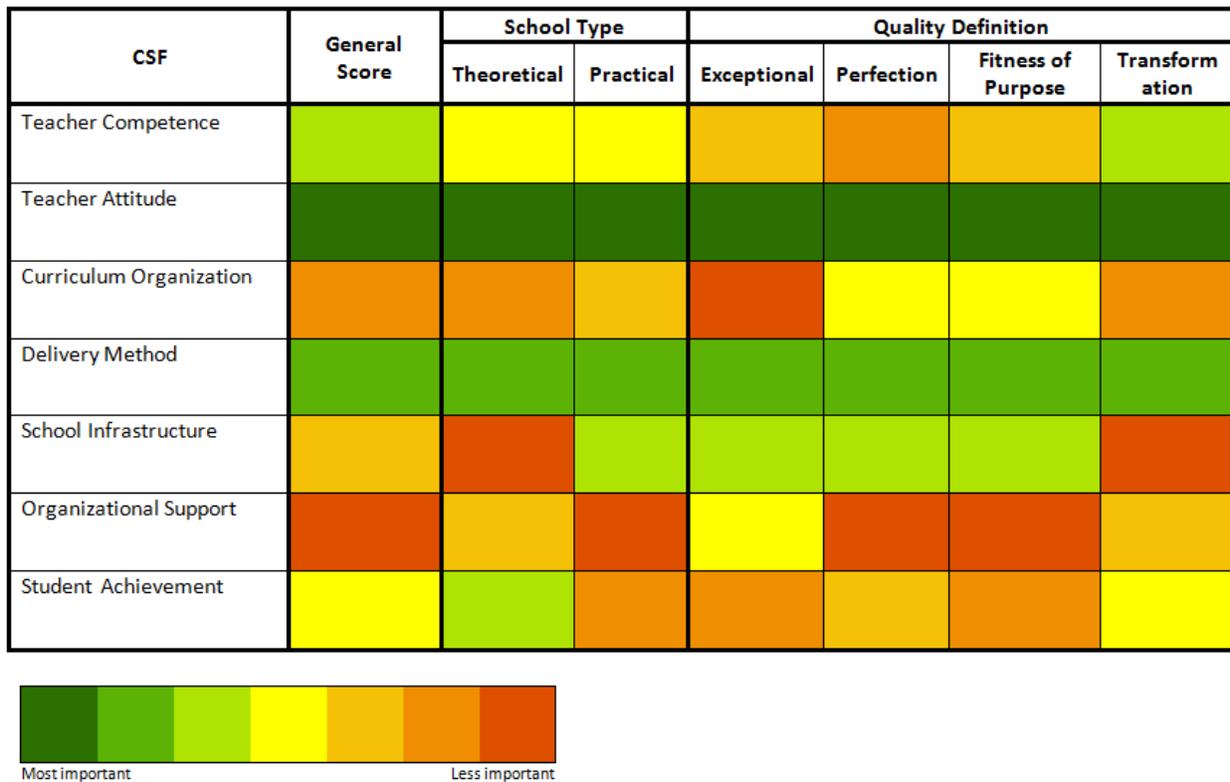


Figure 9 – The Education Quality Indicator (EQI) Framework.

#### 4.5. 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, which we will refer to as EQIS, which is in use in numerous Dutch secondary schools. EQIS handles several modules including financial planning, personnel data management, and students’ study results. 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 by matching it with the currently available data in EQIS. Furthermore, identification of data that is still needed to satisfy each KPI's measurement requirement is needed.

#### 4.5.1. CURRENT DATA MODEL

In its data model, EQIS identifies several different components and uses different terms which are related to this research and its data needs. The detailed data model could be found in Appendix B, while Figure 11 shows the visualization of it.

#### 4.5.2. DATA AND FRAMEWORK ASSOCIATION

The next step is to relate the framework developed to the current EQIS system. This is done through an interview conducted with key experts from EQIS-CORP, who developed the system. The main goal of the interview is to identify what data are 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 Appendix C, which shows the association between currently available data in EQIS and the required data for the framework.

#### 4.6.DASHBOARD MOCKUP

Figure 10 shows a mockup of the dashboard for the KPI Teacher Competence. Each CSF is measured by a combination of data which will give an insight about the quality of that CSF.

	This Year	Previous Year	Objective	Satisfaction
<b>Degree of Competence</b>			To have more teacher closer to the highest qualification (i.e., 1 <sup>st</sup> degree teacher)	 
1 <sup>st</sup> degree Teacher	30%	26%		
2 <sup>nd</sup> degree Teacher	37%	32%		
Under Qualified Teacher	26%	29%		
Unqualified Teacher	7%	13%		
<b>Investment in Teacher Learning (percentage of:)</b>			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 10 - Dashboard Mockup for the EQI KPI: Teacher Competence.

Data are presented with a comparison of last year's result as the benchmark. Further, a plus (+) and/or minus (-) indicator concludes each component measured, so a user can have a quick look at the overall result, enabling identification and prioritization of the components to focus on.

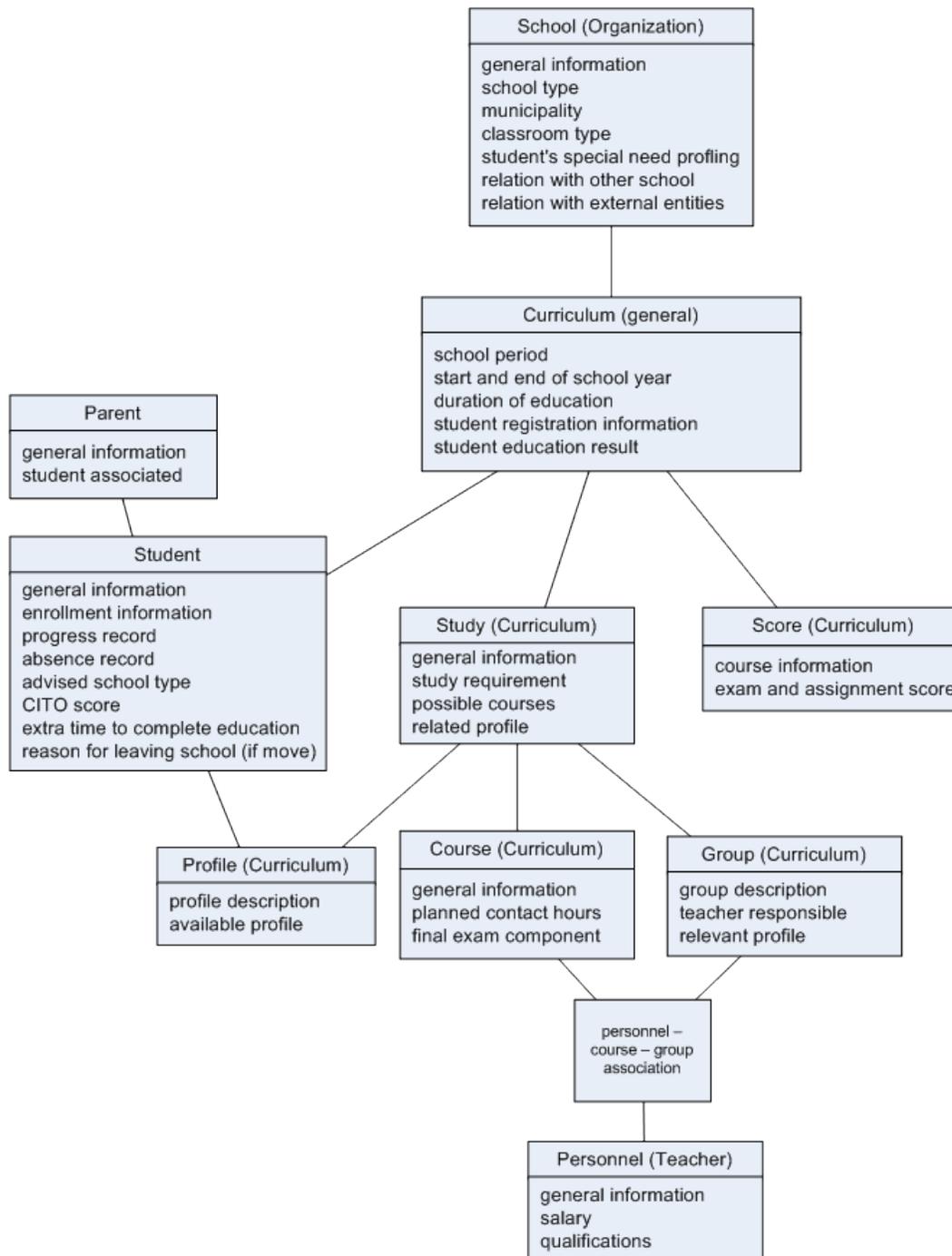


Figure 11 - EQIS Data Model

## **Discussion and Conclusion**

This research tries to answer the research question and sub-questions through a literature review, explorative expert interviews, data analysis, and an online survey. Research findings show that a 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 a vision of education quality into a practical visual tool – a dashboard – to help school management in monitoring their school quality and direct their decision making to achieve good quality education.

The process steps performed in this research yield the Education Quality Indicator (EQI) framework for secondary education quality assessment. This framework provides a well-grounded starting point in further developing a tangible measurement to assure education quality that is general in nature to be implemented at different levels of education and different settings of education schemes.

In every group analysis it was found that Teacher Attitude and Delivery Method are always the two most important CSFs. This shows that a teacher's ability to communicate with students is viewed to be most important in assuring education quality in secondary education.

## Appendix A – Initial Framework

Component	CSF	KPI	Measurement	Data
<b>Teacher</b>	Teacher Competence	Teacher's education and training	<ul style="list-style-type: none"> <li>- Teacher has received training and education in pedagogic and didactic field</li> <li>- 75% teachers are in the group of highly qualified teachers (1<sup>st</sup> degree)</li> </ul>	<ul style="list-style-type: none"> <li>- Teacher's education background record</li> <li>- Teaching level qualifications</li> </ul>
		Teacher holds a diploma aligned with the subject they teach	85% teachers teach the subject with particular diploma they hold	<ul style="list-style-type: none"> <li>- Teacher's education background record</li> <li>- Teacher's course record</li> </ul>
		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	<ul style="list-style-type: none"> <li>- Number of days teachers go conference in their field</li> <li>- Amount of money spent allocated for teacher learning and improvement</li> </ul>
	Teacher Attitude	Highly motivated teachers	Teacher's attendance rate > 90%	<ul style="list-style-type: none"> <li>- Teacher's absence frequency</li> <li>- Teacher's absence duration</li> <li>- Teacher and student survey</li> </ul>
		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	<ul style="list-style-type: none"> <li>- Student survey on teacher performance</li> <li>- Student's absence record (frequency and duration)</li> </ul>
		Teachers are emotionally involved with students	<ul style="list-style-type: none"> <li>- 80% students opine so</li> <li>- Teachers receive good assessment from school management</li> </ul>	<ul style="list-style-type: none"> <li>- Student survey on teacher performance</li> <li>- Teacher's performance review from management</li> </ul>
	<b>Curriculum</b>	Curriculum Organization	School curriculum meets government standard	Government targets and standards are fulfilled
Teaching materials are up to date			Textbooks and study guides are from the last 5 years, or the most recent available	<ul style="list-style-type: none"> <li>- Teacher survey</li> <li>- Course description</li> </ul>
		Curriculum should contain primary knowledge	Materials necessary for aptitude	- Teacher survey

Component	CSF	KPI	Measurement	Data
			(CITO) test should be covered in the curriculum	<ul style="list-style-type: none"> <li>- Management survey</li> <li>- External assessment</li> </ul>
		Curriculum are properly designed and planned	Teaching and assessment plan are detailed into hours and should be available before each quarter starts	<ul style="list-style-type: none"> <li>- Teacher survey</li> <li>- Course description associated to teaching plan</li> </ul>
	Delivery Method	Usage of effective presentation method	At least 80% of students understood the material at the end of study hour	<ul style="list-style-type: none"> <li>- Student survey</li> <li>- External assessment</li> <li>- Student quiz result at the end of contact hour</li> </ul>
		Actively involving student into the process of pursuing knowledge	Classroom average of 7 or higher in assignments that require independent study and decision making	<ul style="list-style-type: none"> <li>- Course description (explains the nature of the course)</li> <li>- Student test results</li> </ul>
		Pay attention to the logical structure of teaching material	Monthly checkpoints on teaching plan that assures there is a build-up on the knowledge	<ul style="list-style-type: none"> <li>- External assessment</li> <li>- Student and teacher survey</li> <li>- Yearly review</li> </ul>
		Usage of methods that improve students' communication skill and team-working	Classroom average of 7 or higher in presentation and group assignments	<ul style="list-style-type: none"> <li>- Course description (explains the nature of the course)</li> <li>- Student test results</li> <li>- External assessment</li> </ul>
<b>Organization</b>	School Infrastructure	Sufficient space and available classroom	<ul style="list-style-type: none"> <li>- School has sufficient space for every student</li> <li>- School has extra room available for unscheduled splitting of class</li> </ul>	<ul style="list-style-type: none"> <li>- Average student per classroom</li> <li>- Average square meter each student has in the classroom (enough space to move)</li> <li>- Classroom occupational rate</li> </ul>
		Reasonable teacher to student ratio	1:20 teacher to student ratio	<ul style="list-style-type: none"> <li>- Teacher record</li> <li>- Student record</li> <li>- Course planning</li> </ul>
		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	<ul style="list-style-type: none"> <li>- School guide</li> <li>- Personnel record</li> <li>- Student survey</li> </ul>

Component	CSF	KPI	Measurement	Data
	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	<ul style="list-style-type: none"> <li>- Student record</li> <li>- School profile (percentage of student that requires special attention)</li> </ul>
		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	<ul style="list-style-type: none"> <li>- School regulation</li> <li>- Teacher and student survey</li> <li>- External assessment</li> </ul>
		Clear evaluation of students' development progress	<ul style="list-style-type: none"> <li>- Quarterly exams with monthly routine tests</li> <li>- CITO test</li> </ul>	<ul style="list-style-type: none"> <li>- Curriculum and academic calendar planning</li> <li>- CITO test score</li> </ul>
		Well recognized school and reputation	<ul style="list-style-type: none"> <li>- School receives award in the last 5 years</li> <li>- School achieve a positive review</li> </ul>	<ul style="list-style-type: none"> <li>- Excellente scholen</li> <li>- Elsevier's de beste scholen</li> </ul>
<b>Student</b>	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	<ul style="list-style-type: none"> <li>- CITO scores</li> <li>- School level entry requirement</li> <li>- Advice from primary school</li> </ul>
		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

## Appendix B –EQIS Data Model

In its data model, EQIS 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 EQIS, 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*) : EQIS 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 EQIS data model and this research with regards to the student. EQIS 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 EQIS 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 EQIS 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 EQIS 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 7 - Correlation between Available Data and Component**

<b>Component</b>	<b>Derived Data</b>
School (Organization)	<ul style="list-style-type: none"> <li>- School general information (name, address, bank account)</li> <li>- School type (education level)</li> <li>- Municipality where the school is registered</li> <li>- Classroom type relevant to registered course</li> <li>- Profiling of students with regards to their special need</li> <li>- Relations school has with other schools and/or other external entities</li> </ul>
Teacher	<ul style="list-style-type: none"> <li>- Teacher (personnel) general information (name, date of birth, nationality)</li> <li>- Teacher (personnel) salary</li> <li>- Teacher (personnel) qualifications (indicates the level of teacher's expertise based on their previous education and experience)</li> </ul>
Student	<ul style="list-style-type: none"> <li>- Student general information (name, date of birth, address, nationality)</li> <li>- Student enrollment information:               <ul style="list-style-type: none"> <li>• Education profile student takes</li> <li>• School type student is in</li> <li>• School year/level student is in</li> <li>• Associated courses (primary and elective)</li> <li>• Start and end date of each course associated to student</li> <li>• Student study information</li> </ul> </li> <li>- Student progress record</li> <li>- Student absence record</li> <li>- Advised school type to student</li> <li>- CITO score</li> <li>- Extra time student require to complete education</li> <li>- Reason student leave school (in case of moving)</li> </ul>
Curriculum (group)	<ul style="list-style-type: none"> <li>- Description of class (group)</li> <li>- Teacher responsible for a class</li> <li>- Education profile relevant to a class</li> </ul>
Curriculum (course)	<ul style="list-style-type: none"> <li>- Course general information (name, code, relevant education type, duration)</li> <li>- Planned contact hours</li> <li>- Final exam components</li> </ul>
Curriculum (study)	<ul style="list-style-type: none"> <li>- Study general information (name, period, duration)</li> <li>- Study requirement</li> <li>- Possible courses to follow in a study</li> </ul>
Curriculum (profile)	<ul style="list-style-type: none"> <li>- Description of profile</li> <li>- Different profiles available for student</li> </ul>

Component	Derived Data
Curriculum (score)	<ul style="list-style-type: none"> <li>- Course information</li> <li>- Exam result</li> <li>- Assignment result</li> </ul>
Curriculum (general)	<ul style="list-style-type: none"> <li>- School period</li> <li>- Start and end of school year</li> <li>- Duration of education</li> <li>- Student enrollment information (association between profile, course, study, group)</li> </ul>
Parent	<ul style="list-style-type: none"> <li>- Parent general information (name, address, nationality)</li> <li>- Associated student(s) to registered parent</li> </ul>

## Appendix C –EQI Framework with Data Associations

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)	Qualitative measurement measure curriculum design best. Combination of external assessment

Component	KPI	Data		Description
		Available	Not Available	
			- External assessment	result, management review, and discussion between teachers from the same subject provide this information.
	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'	- Student test results	- Course description	Course description provides information about the

Component	KPI	Data		Description
		Available	Not Available	
	communication skill and team-working		- External assessment	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.
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.

Component	KPI	Data		Description
		Available	Not Available	
Student	The initial level of student's knowledge meets the school's entrance requirement	<ul style="list-style-type: none"> <li>- CITO score</li> <li>- Advised school type to student (from primary education)</li> <li>- Study requirement</li> </ul>		End of primary education CITO score and advised school type compared to required level of a specific school type, gives an overview of compatibility between student knowledge and requirements.
	High pass rate of student in each school level without having to re-sit a certain level	<ul style="list-style-type: none"> <li>- Student enrollment information</li> <li>- Extra time student require to complete education</li> <li>- Association between student and course</li> <li>- Student progress report</li> </ul>		Student result record shows how students are progressing with their studies.
	Students shows retention and persistence in their performance	<ul style="list-style-type: none"> <li>- CITO score</li> <li>- Exam result (school exam, central exam)</li> <li>- Association between student and course</li> <li>- Student progress report</li> </ul>		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	<ul style="list-style-type: none"> <li>- Exam result</li> <li>- Association between student and course</li> <li>- Final exam components</li> </ul>	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.

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