Using Coh-Metrix to investigate changes in student texts

Comparing student writing from 1999 and 2009

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Abstract
This study investigates Swedish students’ texts from two time periods: 1999 and 2009, in search of cohesive evidence indicating a change of quality influenced by the development of the Internet. The method used in this study is the application of a computational tool that provides measures of language and discourse called Coh-Metrix, which provides measures along several cohesion variables, including word concreteness, deep cohesion, verb cohesion and lexical diversity. The results showed that the student texts from 2009 had higher lexical diversity, suggesting a larger vocabulary, which is closely connected to text quality. The results also showed a higher use of deep cohesion in the texts from 2009, which suggest that the writers know how to use connectives. In contrast, the student texts from 1999 showed a higher use of verb cohesion, suggesting the texts being written in a more narrative style, which is often connected to younger students. By using Coh-Metrix to study evidence of cohesion, this study could contribute with relevant findings about how students’ written English has changed over a period of time.

Keywords
Coh-Metrix, cohesion, student writing, text quality, Extramural English.
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1. Introduction

English as first foreign language was inaugurated in the Swedish state secondary grammar school in the early 1940s and became a compulsory subject in the early 1950s (Johansson, 2004). Since then many curricula have been introduced and there has been a shift from pedagogical focus, from form to function, moving from grammar to oral and written proficiency (Köhlmyr, 2003). This change of focus can be seen as a result of the increasing influence of the Internet and social media which requires more oral and written output. Since young adolescents are frequent users of these outlets, it is of great interest to look at their written production.

Much research has been done on English writing in Swedish schools; however, little work has been done in comparing and analyzing students’ English writing in compulsory schools to see what has changed over time, especially concerning the last twenty years, when the development of information technology has taken place, which has led to a greater exposure to English and new ways of expressing it.

The purpose of this study is to analyze and compare Swedish students’ English texts from 1999 and 2009, using the web tool Coh-Metrix, which measures texts along several cohesion variables, including word concreteness, deep cohesion, verb cohesion, as well as lexical diversity. The texts used for this study are part of the Swedish standardized national test in English and taken from students in their final year of the Swedish nine-year compulsory school.

The research questions concerned in this study are the following: Has the quality of students’ texts from 2009 changed in terms of cohesion compared to students’ texts from 1999; if so, how has it changed?

The aim of this study is to find evidence of improvement, measured in variables of cohesion, in the students’ texts from 2009 and connect the results to previous research done on students’ writing, and discuss the impact from Extramural English (EE), e.g. Internet related activities. Underlying assumptions of this study include the following: that the number of cohesive cues are decisive for more comprehensive texts, and that these cues are closely connected to the quality of text. The hypothesis is that the students’ text from 2009 will show a greater amount of cohesion as a result of increasing exposure to EE, in comparison to the texts written in 1999 when the information technology had just begun to develop.

This study may be of interest to educators of English, as well as researchers interested in written English from second language users, or in cohesion in students’ English texts; but also for developers and evaluators of English writing assignments such as the standardized national test, or as a base for further research, in a larger context or with different methods.
1.1 Background: English in Swedish schools

The English language became an influential language in Sweden in the 17th century due to trade and diplomatic relations; however, it was not until the 19th century that English became a part of the Swedish curriculum, starting at university level and later on becoming a compulsory subject from fifth grade in the early 1950s (Köhlmyr, 2003; Florin, 2010). The influence from how classical languages were taught affected the curriculum; the focus was on grammar and translation. From the 1960s the curriculum gradually changed, focusing less on grammar and more on written and oral proficiency, where emphasis lay on making oneself understood. In the curriculum from 1980 and 1994 the focus lay on oral proficiency, thus the focus of teaching consisted in listening comprehension and oral exercises. One of the goals for written proficiency of the curriculum from 1994 (Lpo94), which was the current curriculum at the time the student texts were composed, stated that students should develop knowledge to be used in simple forms of writing such as messages, letters and summaries (Emrich, 2001). Although the curriculum of 1994 focused less on writing proficiency, it recognized the global significance of learning English as well as the language’s dominant position in the world (Köhlmyr, 2003). The Lpo94 also stated that the teacher has to consider the knowledge that the student has acquired through other ways than school education, indicating that the students’ out-of-school activities were becoming more relevant for schoolwork than before (Nyström, 2000). In the latest curriculum of 2011 the focus has changed to include a development of the students’ use of language structure in dealing with e.g. grammar, spelling and punctuation. Furthermore, it states the importance of using the English language in the surrounding world, e.g. in different media (Skolverket, 2011).

1.1.1 The influence from new technology

It was in the early 1990s that Internet started to spread among early users that mainly consisted of a small educated group with an interest in technology. With HTML the World Wide Web was born and in 1994 Netscape’s browser Mosaic became freely available for everyone facilitating the use and spreading the Internet to more users. Sweden was not among the leading countries but took part relatively early in the development of the Internet. In the years between 1995 and 2000 the rapid development of the first phase resulted in half of the adult population having access to the Internet at home. In the second phase, the development of broadband was decisive in spreading the technology; by 2008, 75 percent of the population had access to broadband, which more than doubled the time spent on the Internet compared to in 1995 when modems were used. In 2008 the mobile broadband over the 3G network was beginning to develop and 14 percent of the population used it; combined with the increasing use of laptops, it made people more mobile, and in 2009, 17 percent could work from their home compared to in 2003 when only 4 percent had that opportunity (Findahl, 2009a).

During the last 17 years, the Internet access among the population has increased for every year. It is a fast development and during the final years of the 90s, 20 percent of the population got access to the internet each year, in other words, 1.5 million new users per
year. In 1995, only 2 percent of the population had access, compared to 89 percent in 2011 (Findahl, 2012).

The Internet access together with new technology have led to many ways of expressing oneself. Today we use our tablets, mobile phones and laptops to work, find information, chat, e-mail, use social media, and to stream music and video. In the years between 1999 and 2009, the time the student texts are taken from, the technical development had not gotten that far. There were not as many users with laptops as there are today since wireless Internet access was not available for many. The main use of the Internet was for e-mailing and finding information from a home computer. In 2009, the main users of Internet were young people between 16 and 25, and the communication through social media was rapidly increasing (Findahl, 2009b).

The fast development of the Internet that began in 1995, and the technology that followed in the following years, make it very interesting to analyze English texts produced during that time. The advance of the Internet is also the advance of the English language in new contexts that might be seen in Swedish students’ use of written English.

1.1.2 Relevant research

There have been several studies of writing in English as a second language; interesting research conducted by Crossley and McNamara (McNamara, Graesser, McArthy, & Cai, 2014) looks at high school Hong Kong students and the quality of their second language English writing. More locally, Nils-Gunnar Emrich (2001) focuses on vocabulary in written compositions by 16-year old Swedish students of English; Pia Köhlmyr (2003) also focuses on 16-year old students of English in her study of grammatical errors in their written texts; whereas Pia Sundqvist (2009) and Eva Olsson (2012) investigate the impact of Extramural English on students’ oral and written proficiency.

New technology develops new ways to communicate, which in turn lead to more interaction in English. How can this increase of English interaction change our way to communicate? The research done by Pia Sundqvist is relevant to this study since it focuses on the impact of English on Swedish students’ writing. Her dissertation from 2009 studies the impact of Extramural English (EE) on Swedish ninth graders’ oral proficiency and vocabulary. Sundqvist defines the term Extramural English as “[…] linguistic activities in English that students do or are involved in outside the classroom in their spare time.” (p. 190)

Sundqvist refers to activities such as surfing the Internet, using social media, reading books and newspapers, playing online videogames, as well as, travelling and communicating with friends or relatives in English. The results of this study show “[…] that the total amount of time which these adolescents spend on various EE activities correlate with their level of oral proficiency and the size of their vocabulary”.

She concludes

[…] that students’ EE has an effect on both oral proficiency and vocabulary, though, the causal relationship is clearer between EE and vocabulary than it is between EE and oral proficiency. (p. 202)
The influence of EE on vocabulary is important for this study as well, since the students from 2009 probably would have been interacting more in English due to the increasing influence of new information technology; and with more interaction comes a possibly larger vocabulary which makes it easier to express oneself in writing.

2. Theoretical Framework

2.1 Communicative competence

Communicative competence is a widely known term in linguistics and has been defined and developed by Hymes (1972), Canale and Swain (1980), and Widdowson (1979), among others. It is basically the notion that knowledge consists of a grammatical or linguistic competence which includes, phonology, syntax, vocabulary and semantics; and of the competence in using this knowledge in an adequate way (Bagarić & Djigunović, 2007; Shaw, 1992). Canale and Swain (1980) divide communicative competence into four competence areas: linguistic competence (as mentioned above), sociolinguistic competence (how to use and respond to language appropriately given the setting, topic and relationships), discourse competence (knowing how to make up a coherent whole of ideas linked across sentences or utterances), and strategic competence (how to recognize and repair communication breakdowns) (Canale & Swain, 1980; NCLRC, 2015).

Applying this theory to the current study, linguistic competence is what the students of English are taught in school, e.g. grammar and vocabulary. Sociolinguistic competence concerns the school environment, the standardized national test and the topic of the assignment. Discourse competence refers to the use of knowledge to write a coherent text by using cohesive cues. Strategic competence has to do with strategies students use when they lack knowledge about how to express themselves correctly, e.g. using a Swedish word instead. These competences work together to convey a coherent message, or at least as coherent as possible due to discrepancies in the different competence areas; knowing the right words and the grammar does not mean that you know how to use them in a specific context. In this specific context, the coherent message consists of written texts produced by students. Coherence in text can be analyzed in different ways depending on the focus; since this study is concerned with text quality and the comparison of texts from two different time periods, a quantitative method to measure coherence is preferable, hence the method to use cohesion.

2.2 The concept of text

Cohesion is what distinguishes a text from a disconnected sequence of sentences. Without cohesion a text is left out to its context in order to be coherent. Although a text is not totally dependent on cohesion, it facilitates understanding, especially if context is not sufficient to create coherence. A definition of some terms is therefore necessary.
The word TEXT is used to refer to any passage that forms a unified whole, both spoken and written. It can be of any length and form, such as a play, a dialog or monologue, or a proverb (Halliday & Hasan, 1976). Halliday and Hasan (1976) define the word TEXT as:

A text is a unit of language in use. It is not a grammatical unit, like a clause or a sentence; and it is not defined by its size. […] A text is best regarded as a SEMANTIC unit: a unit not of form but of meaning. Thus it is related to a clause or sentence not by size but by REALIZATION, the coding of one symbolic system in another. A text does not CONSIST OF sentences; it is REALIZED BY, or encoded in, sentences. (pp. 1-2)

In this study though, the word TEXT will refer to written text, more specifically, the written texts produced by the students.

Although cohesion had been studied before Halliday and Hasan, their contribution with their study Cohesion in English, 1976, marked an establishment of cohesion theory, and their well-known work has spread the concept to many other fields (Xi, 2010). Halliday and Hasan define the concept of cohesion as “[…] a semantic one; it refers to relations of meaning that exist within the text, and that define it as a text.” (Halliday & Hasan, 1976, p. 4) They continue by further outlining their theory:

Cohesion occurs where the INTERPRETATION of some element in the discourse is dependent on that of another. The one PRESUPPOSES the other, in the sense that it cannot be effectively decoded except by recourse to it. (Halliday & Hasan, 1976, p. 4)

This study is based on the concept of cohesion and therefore one assumption is that cohesion can be measured and quantified directly, in contrast to coherence which lies in the mind of the reader (e.g. mental representations drawn from the text) and can only be measured indirectly. Coherence is thus closely, although not directly, connected to the amount of cohesion (McNamara et al., 2014). By quantifying cohesive cues, it is possible to analyze and compare texts and their quality.

2.3 Cohesion and the quality of text

This study is about written texts. However, writing is closely connected to reading and there have been many studies that have focused on the relation between reading and writing knowledge. “The linguistic knowledge shared between reading and writing occurs at all levels, including phonemic, orthographic, semantic, syntactic and discourse structure knowledge” (Cox, Shanahan, & Sulzby, 1990, p. 49). Thus, the importance of cohesion is significant both in the ability to create meaning when reading, and in creating a comprehensible text when writing (Cox et al., 1990). The cohesive cues contribute greatly in creating qualitative texts; “[…] cohesive devices appear to be critical in determining the clarity, appropriateness, and comprehensibility – that is, the quality –of an author's writing” (Cox et al., 1990, p. 50).

The use of cohesion when writing is often an unconscious process, especially if it occurs in lower levels of education, in contrast to higher education where it is often stressed that
the use of cohesion will make a better text and where students learn how to use it. Although this study is about finding cohesion in texts and relating it to quality, the analysis of cohesion will not tell us if it is a bad text or a good text, it will simply tell us something about WHY we think it is good or bad (Halliday & Hasan, 1976).

3. Material

The material used in the study consists of altogether 22 texts from English students in ninth grade in Swedish schools. The texts were selected from different schools and from different parts of the country. The students are both male and female but gender is not considered in this study. The grades given on the students’ texts are also varying and stretches from the lowest to highest grades at that time. The texts are part of the English standardized national test given in 1999 and 2009, 11 from each year.

The texts were provided by the Department of Pedagogics and Special Needs Education (IPS) at the University of Gothenburg, where work and research is done in developing test material for compulsory schools in a project for standardized national tests in foreign languages (NAFS).

The texts were all handwritten and their length varied from 170 to 716 words. For the method used in this study the texts had to be typed into the computer and the spelling had to be corrected, to some extent, in order for Coh-Metrix to be able to analyze them. The spelling has been corrected consistently by correcting misspelled words, so that they could be recognized by Coh-Metrix, but leaving for example errors of concord as long as the word was recognizable, e.g. leaving the verb in: My feelings about Sweden is mixed, and correcting the plural nouns in: Mens and womens can do whatever they want to. In many of the texts, the writers’ names are crossed out to keep the students’ anonymity. To avoid a gap in the text and an incomplete sentence, the names Anna and Karl were used as substitutes.

3.1 The standardized national test

Standardized national tests are given on different subjects in third, sixth and ninth grade of the compulsory school, and also in upper secondary school and adult education. The main purpose of the standardized national test is to function as support for teachers and contribute to an equal and fair grading, and to provide a foundation to analyze whether the required knowledge is being fulfilled. The standardized national tests can also contribute to concretize the syllabi and to increase the fulfillment of the students’ goals. The tests are not examinations but a part of a teachers’ collected information about a students’ proficiency. The Government decides in which grades and in which subjects the standardized national test is carried out, and the tests are composed and evaluated by several universities throughout the country (Skolverket, Prov och bedömning, n.d.).
The standardized national test in English given in ninth grade consists of three parts where students’ oral and written proficiency, and their reading and listening comprehension, are tested. The texts analyzed in this study all come from the written proficiency part of the standardized national test in English. This part of the test consists of a writing assignment which gives the students the possibility to express themselves in writing. The instructions given in the tests offer structured support with content suggestions, as well as some points to follow (see appendices 1 and 2) (Skolverket, Prov och bedömning, n.d.).

In the writing proficiency part from 1999, students were to write an article about their country involving three points to follow: an introduction of oneself, an introduction of one’s country, and a part of more extensive information of one’s country and thoughts about it. A similar assignment was given in the writing proficiency part from 2009, where students were to write about a crossroad; a specific choice they have made or will make. The assignment gives five suggestions as well as three questions to answer about people that inspire and influence them, alternative roads to take, and consequences of their choices. Although the assignments are similar in structure, the topics are very different, one being very concrete while the other more abstract, a difference which will be considered later on in the discussion.

4. Methodology

The method used in this study was the application of a computational tool that provides measures of language and discourse called Coh-Metrix. Coh-Metrix was launched in 2003 at the University of Memphis and has been developed and refined continuously since. The original goals were to develop measures of cohesion but it has also been improved to match texts to readers. “It is arguably the broadest and most sophisticated automated textual assessment tool currently available on the Web” (McNamara et al., 2014, p. 2). Coh-Metrix automatically provides 108 measures of evaluation at text, paragraph, sentence, and word level in less than a minute. The numerous measures are possible due to Coh-Metrix’s use of several lexicons, applications, statistical algorithms, and theoretical advances in language and discourse analysis (McNamara et al., 2014).

4.1 Measures

One important aim of the developers of Coh-Metrix has been to develop measures of text difficulty, or text ease, to get a deeper understanding of how texts differ and which indices and measures are most reliable when detecting these differences. This has resulted in a multidimensional approach of Coh-Metrix easability components that takes into account factors influencing comprehension, especially factors influencing readers’ and writers’ use of knowledge and deep comprehension e.g. cohesion and text genre. This multidimensional approach uses the fact that there are distinctive characteristics of language that function as cues of text difficulty or text ease, which not only can identify how difficult or easy a text is, but also why it is so, by giving a wide range of indices of cohesion. I will be using three of the Coh-Metrix easability components, as presented.
“The easability components provided by Coh-Metrix go beyond traditional readability measures by providing metrics of text characteristics on multiple levels of language and discourse” (McNamara et al., 2014, p. 84). In addition, I will be looking at three measures of lexical diversity to compare vocabulary in the texts.

Easability components used in this study:
Word Concreteness (PCCNCp): Texts containing more concrete words, or content words, easier provoke mental images making the words less difficult to produce and process, in contrast to abstract words which are more difficult to visualize, thus more challenging.
Deep Cohesion (PCDCp): This component measures the causal (e.g. because, then) and intentional (e.g. so that, in order to) connectives which help the reader to form a coherent understanding of the causal and logical relations within a text. When a text is low in deep cohesion, the reader must infer those relations leaving the reader to rely on his or her inferences.
Verb Cohesion (PCVERBp): Text rich in overlapping verbs, i.e. repeated verbs, is more likely to have a coherent event structure, thus facilitating situation model understanding, i.e. the readers’ mental representation of the deeper underlying meaning of the text.

Lexical diversity indices used in this study:
The Measure of Textual Lexical Diversity, all words (LDMTLDa)
Type-token ratio, content words (LDTTRc)
Type-token ratio, all words (LDTTRa)

Lexical diversity is the variety of unique words in a text in relation to number of words. When a text has a high score in lexical diversity it is low in cohesion or very short. When words are repeated frequently in a text, lexical diversity is low and cohesion is high. TTR (type-token ratio) correlates with text length because as the number of words increase the less likelihood is there of unique words. The MTLD index (Measure of Textual Lexical Diversity) solves this problem by using estimation algorithms (McNamara et al., 2014).

5. Results

The aim of this study was to compare texts from Swedish students of English produced in 1999 and in 2009 to see what has changed over a period of ten years, focusing on evidence of cohesion. Many measures were analyzed and the six most relevant measures that were significant after conducting a t-test will be presented.

Word concreteness (PCCNP) refers to the amount of concrete content words such as nouns, verbs, adjectives and adverbs and are presented in percentile. The results show that the texts from 2009 have a higher word concreteness where the mean is 71.05, compared to the texts from 1999 where the mean is 41.47, differing with 29.58. The standard deviation (SD) shows that there is a rather large spread of the results in the texts both from 1999 and 2009. In the texts from 1999 the standard deviation 25.57 show a
spread from one text having 10.38 in word concreteness to another text having 82.12; and the results from 2009 where the standard deviation is 23.18, show one text having 19.77 on word concreteness while another text shows 96.93. However, while the results suggest a concern in the high standard deviation, the conducted t-test value 0.0101 shows that the difference between the groups in terms of word concreteness is in fact significant.

Text easability, **word concreteness**, percentile (PCCNP)
t-test value 0.0101

<table>
<thead>
<tr>
<th>Text</th>
<th>1999</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>82.12</td>
<td>50.80</td>
</tr>
<tr>
<td>2</td>
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<td>6</td>
<td>23.27</td>
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<td>7</td>
<td>58.71</td>
<td>90.49</td>
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<td>8</td>
<td>72.91</td>
<td>87.90</td>
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<tr>
<td>9</td>
<td>12.10</td>
<td>19.77</td>
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<td>10</td>
<td>55.17</td>
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<tr>
<td>11</td>
<td>61.41</td>
<td>79.39</td>
</tr>
<tr>
<td>Mean</td>
<td>41.47</td>
<td>71.05</td>
</tr>
<tr>
<td>SD</td>
<td>25.57</td>
<td>23.18</td>
</tr>
</tbody>
</table>

**Deep cohesion** (PCDCp) is a measure of causal and intentional connectives such as because, then and so, helping to bind the text together to create coherence. The measures of deep cohesion presented here are in percentile. The results show that texts from 2009 have more deep cohesion with a mean of 78.52 compared to the texts from 1999 that have a mean of 50.44, differing with 28.08. The standard deviation is again rather large in both the results from 1999 and 2009, showing a slightly larger spread in the results from 1999. However, the t-test conducted on the measures of deep cohesion shows a significant value of 0.0087.

Text easability, **deep cohesion**, percentile (PCDCp)
t-test value 0.0087
The measure of **verb cohesion** (PCVERBp) refers to the amount of overlapping verbs in a text, where a high percentile suggests a higher use of verb cohesion. The results show that the texts from 1999 have more verb cohesion, with a mean of 75.26, than the texts from 2009 that have a mean of 51.79, a difference of 23.47. The standard deviation for the texts from 1999 is 14.85 compared to the texts from 2009, which have a standard deviation of 22.20. This suggests that there is a larger spread in the results of verb cohesion in the texts from 2009 where one text shows a result of 20.90 while another shows a result of 97.26. However, although the texts from 2009 show a larger standard deviation, the t-test conducted shows a significant value of 0.0094.

**Text easability, verb cohesion, percentile (PCVERBp)**

t-test value 0.0094

<table>
<thead>
<tr>
<th>Text</th>
<th>1999</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>58.71</td>
<td>21.48</td>
</tr>
<tr>
<td>2</td>
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<td>3</td>
<td>78.23</td>
<td>62.17</td>
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<td>4</td>
<td>90.66</td>
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<td>6</td>
<td>90.66</td>
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</tr>
</tbody>
</table>
The Measure of Textual Lexical Diversity (MTLD) is an index of lexical diversity that is independent of text length, thereby making it a more reliable measure. The results show that the texts from 2009 have larger variety of words, the mean is 72.788; while the texts from 1999 show a mean of 52.967, a difference of 19.821. The standard deviation is 23.326 in the texts from 2009, in contrast to the texts from 1999 that has a standard deviation of 11.588. The range between the results of the standard deviation of the 2009 texts stretches from one text having a measure of 40.464 to another text having a measure of 118.697. The t-test conducted, however, shows a significant value of 0.0237.

Lexical diversity, The Measure of Textual Lexical Diversity, all words (LDMTLDa)
t-test value 0.0237

Table 4

<table>
<thead>
<tr>
<th>Text</th>
<th>1999</th>
<th>2009</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>74.702</td>
<td>104.992</td>
</tr>
<tr>
<td>2</td>
<td>50.122</td>
<td>74.588</td>
</tr>
<tr>
<td>3</td>
<td>53.940</td>
<td>50.827</td>
</tr>
<tr>
<td>4</td>
<td>60.096</td>
<td>80.733</td>
</tr>
<tr>
<td>5</td>
<td>69.637</td>
<td>67.940</td>
</tr>
<tr>
<td>6</td>
<td>46.655</td>
<td>118.697</td>
</tr>
<tr>
<td>7</td>
<td>35.580</td>
<td>75.804</td>
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<td>8</td>
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<td>40.639</td>
<td>65.667</td>
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<td>10</td>
<td>53.800</td>
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<td>11</td>
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<tr>
<td>Mean</td>
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<td>72.788</td>
</tr>
<tr>
<td>SD</td>
<td>11.588</td>
<td>23.326</td>
</tr>
</tbody>
</table>
The index measuring type-token ratio for content words (LDTTRc) refers to the lexical diversity of content words such as nouns, verbs, adjectives and adverbials. Types refer to every unique word in a text while tokens are the total number of words in a text (McNamara et al., 2014), when the number of unique words (types) are divided with the total amount of words (tokens) we get the type-token ratio (TTR), i.e. a measure of how many unique words there are in a text. This TTR measures content words. The mean is 0.627 for the texts from 1999, which is slightly lower than the mean of the texts from 2009 which is 0.701. The standard deviation is also somewhat higher in the texts from 1999 but only differing with 0.015 from the texts produced in 2009. The t-test conducted shows a significant value of 0.0112.

**Type-token ratio, content words (LDTTRc)**

t-test value 0.0112

<table>
<thead>
<tr>
<th>Text</th>
<th>1999</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.663</td>
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<tr>
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<td>0.713</td>
</tr>
<tr>
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</tr>
<tr>
<td>Mean</td>
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<td>0.701</td>
</tr>
<tr>
<td>SD</td>
<td>0.069</td>
<td>0.054</td>
</tr>
</tbody>
</table>

The last index measuring lexical diversity is another index of the type-token ratio. This index measures all words. The mean of the texts from 1999 is 0.441 which is slightly lower than the mean from the texts from 2009 which is 0.493, showing a difference of 0.052. The standard deviation is slightly higher in the texts from 1999 compared to the texts from 2009, but differing only with 0.004. The t-test conducted shows a significant value of 0.031.

**Type-token ratio, all words (LDTTRa)**

t-test value 0.031
6. Discussion

In this study I analyzed 22 texts produced by Swedish students of English, 11 texts from 1999 and 11 texts from 2009, using the assessment tool Coh-Metrix in search of cues of cohesion as measures of quality and as variables changing over time. All the texts were part of the ninth grade standardized national test in English and retrieved from students from different parts of Sweden, from both male and female students, representing the spectrum of grades relevant at that time. The texts were keyed into a computer and edited before being analyzed in Coh-Metrix. After looking at several measures I conducted t-tests on all the relevant measures before choosing the six measures presented in this study.

The aim of this study was to analyze changes of students’ written English measured in cohesion in a ten-year span, with the hypothesis that students’ text from 2009 would show a higher quality in their texts identified by their use of cohesion.

The results showed a much higher use of concrete words in the texts from 2009 (see table 1). This might suggest that the students from 2009 use more specific words thus having a larger vocabulary due to their greater exposure to English through the Internet. This suggestion is in line with the research done by Sundqvist (2009), where the results show that the amount of time students’ spent on activities related to Extramural English (e.g. Internet related activities in this study) correlates positively with students’ size of vocabulary (Sundqvist, 2009). In other words, the students from 2009 might have a larger

### Table 6

<table>
<thead>
<tr>
<th>Text</th>
<th>1999</th>
<th>2009</th>
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<tr>
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<td>0.418</td>
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<tr>
<td>Mean</td>
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<td>0.493</td>
</tr>
<tr>
<td>SD</td>
<td>0.051</td>
<td>0.055</td>
</tr>
</tbody>
</table>
vocabulary due to their frequent involvement in Internet activities such as using social media or playing on-line games. Furthermore, the results measuring lexical diversity (see tables 4-6) support my suggestion by showing that the texts from 2009 have a higher amount of lexical diversity, thus having many different words and larger vocabulary, moreover, it would imply that the texts are low in cohesion. In contrast, the texts which have a lower score on lexical diversity would be high in cohesion thus having fewer words repeated. In addition, a text being coherent does not always mean it being high in cohesion; it often correlates with the readers’ ability to make inferences. The texts from 2009 show less cohesion but do not need to be harder to understand if the reader makes the right inferences thus helping in creating coherence (McNamara et al., 2014).

The results also showed a higher use of deep cohesion in the texts from 2009 (see table 2). In other words, the students from 2009 use more causal and intentional connectives in their writing than the students from 1999. This might suggest that the students from 2009 know more words, thus including connectives, and how to use them. Moreover, the results measuring verb cohesion (see table 3) show that the texts from 1999 have a higher use of verb cohesion. This result suggests that the students from 1999 produced more narrative texts creating a more coherent event structure, furthermore, this measure is often used for looking at texts written for younger readers (McNamara et al., 2014). However, these two results might also be related to a difference in topic in the two standardized national tests (see appendices 1 and 2). The test from 1999 has a topic called This is my country, where the students write about geography, climate and its effect on life, festivals, culture and how life in general is in Sweden. The topic might be seen to steer the text in its use of verbs creating more causal effects, i.e. that something has happened based on something that has occurred earlier. The topic thus refers to events that describe an overall concrete subject (my country). In contrast, the topic of the test from 2009 is called Crossroads, in which the students write about a change of great importance that has taken place in their lives or that will take place in the future. The theme of this topic refers to events that might not yet have taken place and that are on a more abstract level thus steering the use of more connectives to clarify abstract thoughts and ideas in the text. In sum, the results of the measures of deep cohesion and verb cohesion show different usages of cohesion which might be a consequence of the difference in topic.

The hypothesis in this study presupposes that cohesion constitutes evidence for more comprehensive texts, that such cohesion is closely connected to the quality of texts, and that the texts from 2009 would contain more such evidence. However, in this study the results have shown that the texts from 2009 do not always show more cohesion in the measures analyzed, e.g. verb cohesion (see table 3). It need not be the case that texts of higher quality are always connected with more cohesion. Several studies performed on the reverse cohesion effect support this view. Instead, the effects of cohesion depend on the readers’ prior knowledge, i.e. readers with low knowledge gain more from texts high on cohesion while readers with higher knowledge gain more from texts low on cohesion because their higher knowledge enables them to make more inferences (McNamara et al., 2014). In addition, further research suggests that readers use their reading knowledge when writing and that there are significant correlations between reading ability and writing quality (Cox et al., 1990). In sum, the students from 2009 might not always show
results of high cohesion in the analyzed measures but this result may also be because they might have greater prior knowledge which they use in their writing.

To further support the hypothesis that the students from 2009 would produce texts of higher quality, I refer to research done by Crossley and McNamara where studies examining essays by second language students show that essay quality is related to lexical sophistication, including greater lexical diversity and lower cohesion (McNamara et al., 2014). In other words, the texts from 2009 suggest having higher quality when looking at the results in terms of lexical diversity.

On the other hand, when discussing quality, we should keep in mind that cohesion is only a part of what constitutes a qualitative text. As put by Halliday and Hasan (1976) “Cohesion does not concern what a text means; it concerns how the text is constructed as a semantic edifice.” (p.26) Thus, what a text means, or what meaning a texts conveys, can also be part of what constitutes a qualitative text, and this can be difficult to measure. To conclude, some aspects of writing quality, e.g. rhetorical and pragmatic aspects of language, cannot be counted or measured using Coh-Metrix (McNamara et al., 2014).

Even though text quality is difficult to measure by only using Coh-Metrix, this method shows important and contributing results which can be used with complementing methods for a more comprehensive study of text quality. However, what this method can tell us is how students’ written English has changed, regarding cohesion, in a period of ten years, which also were ten crucial and influential years in the development of information technology.

To conclude, the research questions concerned in this study were if the quality of the students’ texts from 2009 had changed in terms of cohesion compared to the students’ texts from 1999, and if so, how had it changed? Based on the results from this study, the text quality seems to have changed in the texts from 2009 regarding the cohesion variables analyzed; especially concerning lexical diversity. This suggests that the students from 2009 have a larger vocabulary, possibly connected to a larger exposure to English activities outside the classroom.

7. Limitations and Further Research

The findings of this study support previous research done by Sundqvist (2009) by suggesting that the students from 2009 use a larger vocabulary due to their exposure to Extramural English. It also supports my hypothesis that the students from 2009 would produce more qualitative texts, however, only in regards to cohesion.

Although this study produced some significant and potentially important findings, there were limitations. As mentioned, measuring text quality might include more features than cohesion, such as prior knowledge and context, thus considering complementary methods when conducting further research. Furthermore, to process the texts in Coh-Metrix, they had to be corrected, a difficult task which requires consistency, and which might overlook the students’ linguistic competence of spelling, and which also could contribute to the overall quality of text. Another limitation was the topic difference in the two standardized
national tests. It might be that the difference in topic steers the students’ choice of words and style. As a consequence, the results from each time period makes it harder to draw general conclusions. So, if further research would be conducted, it is recommended to use tests with more similar topics.

However, the greatest limitation in this study was the corpus, that is, the limited number of texts from students of English in ninth grade. With more time and resources, a larger study of how texts from Swedish students of English have changed over time, would be an interesting and rewarding study that might be useful for teachers or other educators of English, as well as for developers and evaluators of English tests and assignments.
8. References


Appendix A

Part of the standardized national test in written proficiency from 1999.

This Is My Country

Write an article about your country. It may be the country you live in now, or some other country. The important thing is that you feel that it is your country.

You are given three points to help you. Of course you can add other things too.

- **Introduce yourself**
  Write a few lines about yourself and the place where you live.

- **Introduce your country**
  Part of the world?
  Neighbouring countries?
  Population? Size? Climate?
  How people live—school/work/spare time?
  Feelings about your country?

- **Write more about your country, for example about**
  history, geography
  religion, traditions, culture
  politics
  famous people and places
  the environment
  relations to other countries
  schools and education
  the future of your country
Appendix B

Part of the standardized national test in written proficiency from 2009.

Write about a choice that you have made recently or that you will be making in the near future or the year to come.

It could be about:

- What to study and work with
- Where to live
- Family and friends
- Spare time activities
- Politics, religion, the environment

What / who inspires you?

What alternatives are there?

What are the consequences?

Describe and explain to make your reader understand!