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Opleiding Informatica

A New Way of Learning English:

Integration of Computational Thinking Through Digital Storytelling

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Abstract

Computational thinking (CT) is a problem solving method that can be used for any kind of problem that needs to be solved. The focus of the thesis is to find out what the influences of the integration of CT through digital storytelling are for the implementation of it within the Dutch school curriculum for the subject English.

The study was focused on the second year high school students' English lessons. The aim of the study is to find out what kind of influence the making of a digital story has on the students' English learning skills, and CT learning skills, as well as to find out what the students' and the teacher's attitude are concerning digital storytelling as a method of integrating CT. The influence of the CT integrated lessons were investigated by analysing the students' digital stories, the filled in surveys, and the semi-structured interviews wherewith the students and the teacher were interviewed.

The results shows that the students, through creating a digital story, enjoyed the lessons more. The teachers mentioned that because of the way the learning objectives have been taught, that the students understood it better as well as that it will stick longer with them. The students were also able to practice with their pronunciation and writing skills and were allowed to be very creative.

Contents

1   Introduction

This chapter outlines the background of the research (section 1.1), the purposes of the thesis (section 1.2), and an overview of the thesis (section 1.3).

1.1   Background

In (2006) Jeannette M. Wing introduced the term computational thinking. According to Jeannette M. Wing, Computational thinking is the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent (Wing, 2010). Jeannette M. Wing also states that CT is a fundamental skill for everyone, not just for computer scientists (Wing, 2006). A way of problem solving is something that is needed in every subject whether it has something to do with computer science or even a language subject such as English. It is important to know that CT is a way humans solve problems, meaning that it can be integrated in all kinds of subjects.

Kordaki and Kakavas state the following: "CT has become a subject of worldwide attention during the last decade as part of multiple efforts to bring computer science and its concepts into K-12 education. In fact, many attempts have been conducted with the intent to promote new ways of CT-acquisition by K-12 students across all scientific fields, not only STEM." (Kordaki & Kakavas, 2017, p. 2). In the literature review the essence of this study will be more elaborated as it will show the different studies that have been done on this subject.

1.2   Purposes

There are arguments for the use of applying computation thinking as a problem-solving method. A few potential benefits of the integration of CT into the Dutch school curriculum for the subject English could be the development of students' conversation skills as well as an improvement in their collaboration skills. To know the benefits of the integration of CT into the Dutch school curriculum with English being the subject, it is needed to find out if the integration of CT has an influence on the way students perform while being taught a subject. The purpose of this thesis is exactly that. Because CT can be integrated in various ways and in various subjects, such as languages, mathematics, music, engineering and so on, this thesis will focus on one of the ways to integrate it. The thesis will only focus on one subject in the Dutch school curriculum. The subject the thesis is focused on is the English subject and the research question is as follows: "What is the influence of the integration of CT through digital storytelling with Scratch in the subject English?" At the end of the study the thesis will show if the integration of CT through digital storytelling with Scratch has an effect on the performance of students while following the subject English. The thesis will show this by giving an answer to the following sub-questions:

I. What is the influence of the integration of CT through digital storytelling on the students' learning outcome related to their English skills?

II. What is the influence of the integration of CT through digital storytelling on the students' learning outcome related to their CT skills?

III. What attitude do the students have towards the CT integrated lessons through digital storytelling?

IV. What attitude does the teacher have towards the CT integrated lessons through digital storytelling?

1.3 Thesis Outline

The outline of the thesis is as follows. This chapter contains the introduction; Chapter 2 discusses the literature review; Chapter 3 describes the Methodology; Chapter 4 shows the results; Chapter 5 concludes.

2 Literature Review

This chapter reviews literature on the following topics: Computational Thinking (section 2.1) which reviews what CT is and when it was introduced; integration of computational thinking into language art (section 2.2) which reviews a few of the past studies into the integration of CT regarding languages, and digital storytelling (section 2.3) which reviews what digital storytelling is and reviews studies done into digital storytelling and their results. The aim of the research is to see if the integration of CT through digital storytelling with Scratch in the English subject has an influence on the performance of students. The research will mainly be looking at the improvement of the vocabulary and grammar of the students, whether the learning objectives have been understood by the students, as well as the CT skill development, their attitude during the lesson series and the attitude of the teacher.

2.1 Computational Thinking

CT is a skill of significant benefit to multiple disciplines and is not just limited to computer science and technological fields (Mohaghegh & McCauley, 2016). Mohaghegh and McCauley (2016) mention that CT is beneficial, because CT helps us to understand problems and subproblems that are computable. CT also helps thinkers to determine the correct tools and methods for solving certain problems, and CT also helps the exploration of method limitations. Mohaghegh and McCauley (2016) also mention that almost all disciplines have been influenced by CT in some way, in both the sciences and humanities.

2.1.1 Definition of CT

As stated in the introduction, the term CT was first introduced by Jeannette M. Wing in 2006. When the term was introduced the Jeannette M. Wing said that CT is the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent (Wing, 2006). However, Selby and Woollard (2013) stated that the discussions of a definition for CT are not yet concluded. The reason being that it may well be that the definition changes as understanding of CT develops over the years. The proposed definition Selby and Woollard (2013) did come up with in their report is that CT is an activity, often product oriented, associated with, but not limited to, problem solving. It is a cognitive or thought process that reflects:

- the ability to think in abstractions

- the ability to think in terms of decomposition

- the ability to think algorithmically

- the ability to think in terms of evaluations

- the ability to think in generalizations

The ability to think in abstraction is being able to figure out what information is needed to solve a problem. Wing (2008) states that the abstraction is the essence of computational thinking.

The ability to think in terms of decomposition is to be able to break down a problem into smaller parts. Kong (2019) states that decomposition is a core element of a computational thinking process and that it ensures that even complex problems can be understood.

The ability to think algorithmically comes down to the ability of developing a step-by-step means of achieving the solution.

The ability to think in terms of evaluations means to be able to make sure that the solution is fit for the purpose as well as being able to think of improvements.

The ability to think in generalizations means to be able to solve new problems based on solutions used for previously solved problems.

2.2   Integration of CT into Language Art

CT has been integrated into a lot of disciplines already. Burke (2012) states the following: "While few would argue that language-based literacy is less important in the new millennium, it is also clear that the traditional conception of literacy as simply reading and writing text alone is insufficient for the kinds of communicative practices that already characterize 21st Century communication." (Burke, 2012, p. 132). A lot of studies have been done in regards to the integration of CT into the language art. A few examples are computer-based microworlds and digital storytelling. A study of each of these examples will be shared with their conclusion.

The findings of Jenkins' (2015) study, which was a comparative quantitative evaluation of an approach to teaching poetry in the subject domain of English that employs a 'guided discovery' pedagogy using computer-based microworlds, revealed that there are potential quantifiable gains in performance that could be achieved as a result of incorporating elements of a microworld-based pedagogy into classroom practice. Jenkins also stated that it is clear, with close to 80% confidence, that learners who received the microworld-based intervention in teaching practice made a higher improvement in computational thinking and poetic thinking than their counterparts who did not.

Chang's (2019) findings from the study, which aimed to investigate the interrelationship between the learning of CT and digital curation (DC) through digital storytelling, particularly from the elementary school children, revealed the following: "From analysis of the Curation Measure, we found students were most engaged in the content selection and story organization activities. Significant differences in mean scores between the five dimensions guided us to recognize students' insufficient knowledge when curating a story with Scratch. From analysis of the Computation Measure, students' learning performances were consistent with the level of difficulty of each CT concept. Though no significant difference was found in mean scores for each of the five CT concepts, students tended to struggle with integrating the more abstract, complex CT concepts (i.e., conditionals, loops, and variables) into digital storytelling activities. Further investigations revealed a significant, positive correlation between the content organization dimension and the design of sequence concept in CT. In addition, the content interactivity dimension was significantly correlated with the design of conditionals and loops constructs of CT. These findings led to an interdisciplinary collective perspective on the assessment of a student's learning of CT and DC practices" (Chang, 2019, p. 61).

It is clear that the integration of CT has had an effect on students when CT was integrated into the language art, like the increase of the improvement in computational thinking and poetic thinking.

2.3   Digital Storytelling

Smeda et al. (2014) share the definition of digital storytelling as follows: "Digital storytelling is defined by The Digital Storytelling Association, as a "modern expression of the ancient art of storytelling" (The Digital Storytelling Association 2011). Although there is not a single digital storytelling definition, the majority emphasise the use of multimedia tools including graphics, audio, video, and animation to tell a story." (Smeda et al., 2014, p. 4).

2.3.1   Benefits of Digital Storytelling Concerning the English Development

Nair and Yunus (2021) did a study to answer the research question on the role of digital storytelling in improving students' speaking skills. In their study the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) was used to systematically review 45 articles sourced from Google scholar and ERIC. Nair and Yunus state that the articles that were used showed that digital storytelling can be used as a useful tool by educators in improving students' speaking skills from various levels of education, ranging from primary to tertiary education. Their conclusion: "Students who take part in the development of digital stories can improve their communication skills by learning to express themselves, ask important questions, share their perspectives, and create narratives, as all of these help sharpen students' speaking skills. Moreover, students are allowed to share their work with their peers, and in that process, they will acquire highly valued experience in criticising their work. This can also encourage better speaking capabilities and promote students to gain a higher level of emotional intelligence, enjoy better collaboration levels and engage more constructively in the social learning process." (Nair & Yunus, 2021, pp. 12-13).

Di Blas et al. (2012) state that another benefit of digital storytelling is the possibility of creativity. They state that: "collaboration in story authoring can bring important benefits, by fostering creativity, engagement, curiosity and openness beyond the boundaries of the classroom. If employed in multinational settings, virtual collaboration in storytelling activities can also enhance cultural understanding, and enable children to embrace openness to diverse cultural viewpoints." (Di Blas et al., 2012, p. 276).

2.3.2   Benefits of Digital Storytelling Concerning the CT Development

Parsazadeh et al. (2020) in their study to find out whether integrating CT into English language learning can be useful for improving learners' motivation and performance concluded as follows: "The outcomes of this study show that the CT strategy and Scratch software can provide an effective problem solving strategy during storytelling, which is able to reduce the negative emotions in students during digital storytelling. Additionally, CT and Scratch increase curiosity, interest, and interaction between students, which can lead to increases in their learning motivation in regard to the English language. Second, instead of using imagination in storytelling, CT can provide a

logical scaffolding and structure for students when creating their stories in order to enhance their language learning performance. . . . A well-structured and supportive learning strategy can motivate students to solve problems and make decisions during the digital storytelling process." (Parsazadeh et al., 2020, pp. 20-21).

3   Methodology

This chapter describes the design adopted by this research to achieve the aims and objectives stated in section 1.2 of Chapter 1. This chapter discusses the research design used in the study (section 3.1) and the stages of the lesson design by which the research design was implemented (section 3.2). Furthermore, it details the participants in the study (section 3.3), it lists all the instruments used in the study (section 3.4) and finally, it discusses how the data was analysed (section 3.5).

3.1   Research Design

The research design that was used in the thesis is a case study which was held in a high school. A case study can be defined as follows: "A case study is here defined as an in-depth, multifaceted investigation, using qualitative research methods, of a single social phenomenon. The study is conducted in great detail and often relies on the use of several data sources." (Feagin, Orum, & Sjoberg, 1991, p. 2). Some of these data sources are observations, interviews, surveys and analysed document. These are the data collection instruments used for the case study in this thesis.

According to Zainal (2007), there are three advantages in using case studies. The first advantage she mentions is that the examination of data is oftentimes conducted within the context of its use, meaning within the situation in which the activity takes place. The second advantage Zainal mentions is that variations in terms of intrinsic, instrumental and collective approaches to case studies allow for both quantitative and qualitative analyses of the data. The third advantage Zainal mentions of using case studies is that the detailed qualitative accounts often produced in case studies not only help to explore or describe the data in real-life environments, but also help to explain the complexities of real-life situations which may not be captured through experimental or survey research.

Along with these advantages, Zainal also mentions three disadvantages in using case studies criticised by Yin (1984). First, Zainal mentions that case studies are often accused of lack of rigour. Second, case studies provide very little basis for scientific generalisation since they use a small number of subjects, some conducted with only one subject. This can lead to the question "How can you generalise from a single case?". Third, Zainal mentions that case studies are often labelled as being too long, difficult to conduct and producing a massive amount of documentation.

This thesis focuses the case study on the integration of CT through digital storytelling in Scratch within the Dutch school curriculum. The subject focussed on in the case study is narrowed down to one subject being English. The idea is to look for the effectiveness of the integration of CT within this case study or to see if it even has an effect at all. During this experiment the thesis was focussed on the components of CT and applied the components of CT in the lesson series.

3.2   Lesson Design

The experiment had a duration of seven weeks with one lesson each week. The duration of each lesson is one hour, apart from the last week, which had a duration of two hours. The

first three lessons took place in a classroom, the following three lessons took place in a computer lab, and the last lesson took place in a conference room. During these weeks the students had an introduction lesson of the assignment as well as the Scratch environment. It was up to the students to choose whether they preferred to work with Scratch or another programming language. The students also practised with their new gained knowledge and afterwards started working on their assignment. At the end of the lesson series the students were asked to present their work to their fellow students. The students were graded by the predefined rubric. The rubric indicates that the project will be graded based on the structure of their story, the graphics used in their digital story, the programming and creative implementation of their digital story, the English grammar and spelling used in their digital story, the pronunciation of their recorded voices as well as the amount of required content they have implemented in their digital story.

The experiment started with the teacher informing the students what they will be doing during the weeks that were to come. In the first lesson the assignment was handed out to the students wherein the students could find the lesson plan, the task assigning, the requirements for the assignment, the storyboard as well as how the rubric for the grading.

In the first lesson the students were assigned to divide the tasks in their group, come up with the genre of their story as well as to start working on their storyboard. In the storyboard the students could create a scratch of what they would like to see in their end project. During the dividing of the tasks a few examples are provided to help the students along the way.
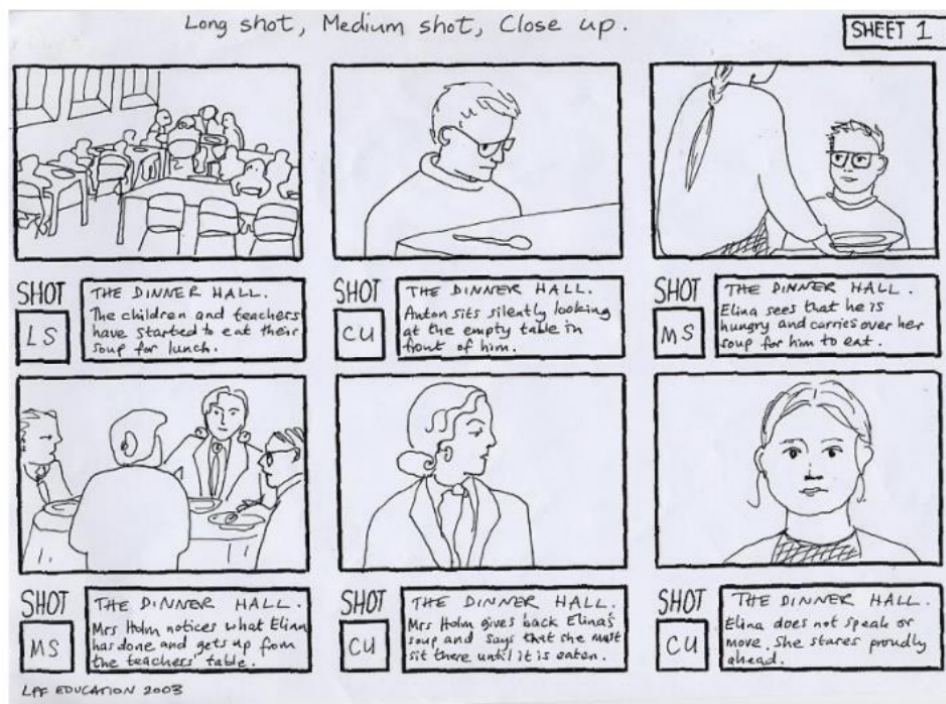

Figure 1: Storyboard example.

During the second lesson the teacher started to explain the requirements of their story being the implantation of the Freytag's pyramid within their story as well as the use of foreshadowing. The requirement from the technical side is the implementation of an interaction with the user while following the story. These are the elements the students were asked to think about beforehand.

In the third lessons a short introduction was given for the use of Scratch. Because the students are familiar with the Scratch environment the researcher only reminded the students how to save their project so that at the end of the experiment the researcher could collect the end results. The researcher also showed the students how to use if/else-statements, variables and how to use user interaction so that the students can get familiar with this in their project. After the introduction the researcher asked the students to create a short quiz which would allow the students to get used to the user interaction within the scratch environment. The website scratch.mit.edu explains Scratch as follows: "Scratch is the world's largest coding community for children and a coding language with a simple visual interface that allows young people to create digital stories, games, and animations. Scratch is designed, developed, and moderated by the Scratch Foundation, a non-profit organization. Scratch promotes computational thinking and problem-solving skills; creative teaching and learning; self-expression and collaboration; and equity in computing."

In the fourth lesson the researcher allowed the students to continue working on the quiz for the first half of the lesson. While the students were working on the quiz the researcher was walking through the classroom to see if the students were having any difficulties with the interaction between the user and their program. In the second half of the lesson the researcher asked the students to start working on their digital story.

In the fifth and sixth lesson the researcher gave the students the time to work on their digital story. The researcher was walking around to see whether the students might face some difficulties as well as help the students out if they do encounter any difficulties. At the end of the lessons the researcher reminded the students of the deadline and assignment to come. The researcher also gave the students sub-tasks that they might want to have finished before the next lesson starts as a guidance in the planning.

In the last lesson the students presented their digital story. The students were asked to first introduce themselves, afterward share the title of their digital story and tell a little bit about the setting of their digital story. The students also explained how their interaction between the listener and their digital story works. After all the digital stories have been presented, the students were asked to fill in the exit ticket, a rubric self-assessment for their CT skills as well as a project self-assessment. After this the researcher did an interview with four of the groups that were participating in the case study. At the end of the study the teacher was also interviewed.

3.3 Participants

The group of students participating consist of 29 students divided into nine groups with one group of two students, five groups of three students and three groups of four students. The students consist of 19 boys and 10 girls with the students being between the age of 13 and 15 years old. The average age of the class is 13.2 years old.

Gender \ Age	12	13	14	15	Total
Boy	1	13	4	1	19
Girl	2	6	1	1	10

Table 1: Gender and age of the participants.

The students are all part of the same class and are in their second year of het voortgezet onderwijs. All the students have had a programming lesson with the majority of the class having experience in coding using Python as the programming language. The second programming language that the students are familiar with is Scratch.
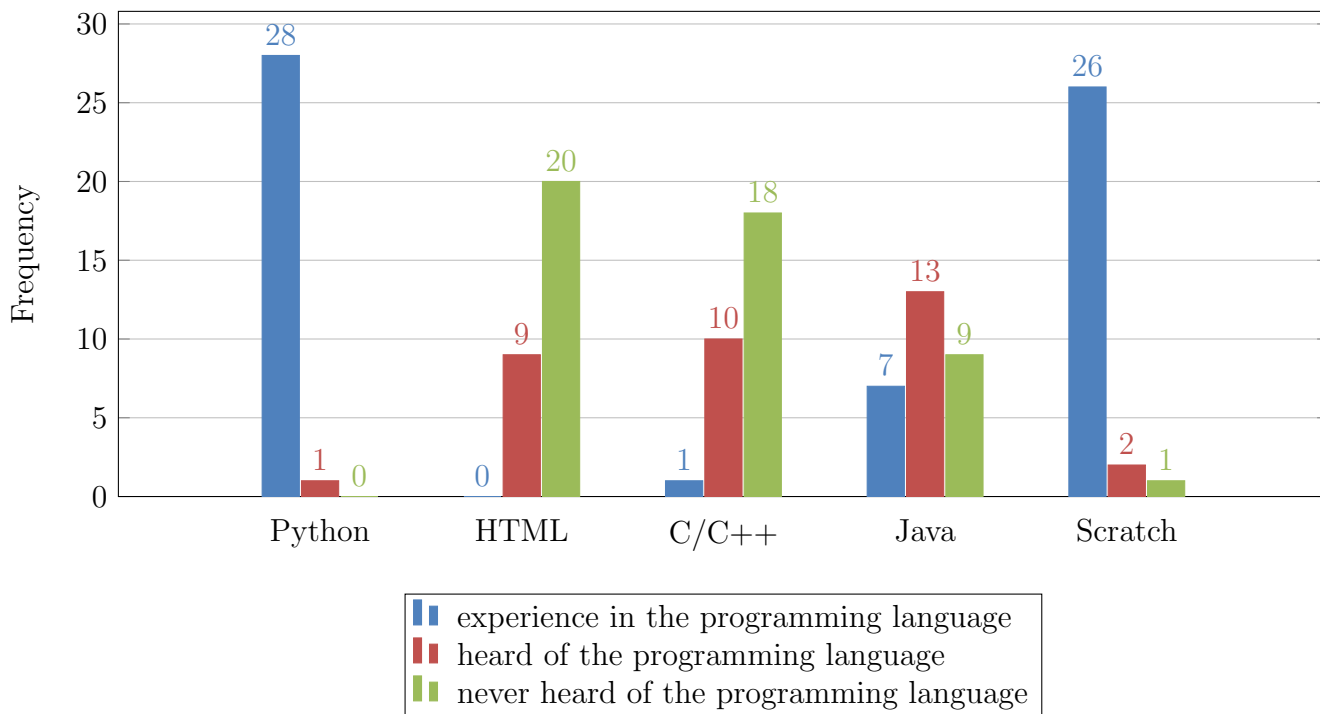

Figure 2: Programming experience of the students.

The teacher that participated in this experiment is an English teacher with 12 years of experience in teaching. The teacher has very little to no experience in programming.

3.4   Data Collection Instruments

The data collection instruments consist of a few different instruments. First of all, the observations of the researchers. Furthermore, the project self-assessment survey, CT self-assessment survey and an exit ticket were used to voice the opinions of the students. There were also interviews held with four groups of students as well as the teacher.

In the demographic survey the students were questioned about their experience with programming. The demographic survey consists of five questions all focussed on their programming knowledge and experience. This survey also asked for the students name, age, gender, group members as well as the title of the students' digital story.

At the end of the experiment in the last lesson the students were asked to fill in three surveys. One of the surveys was a project self-assessment survey, which consists of seven ordinal questions. This survey asked the students how they would evaluate their own work and skills. It asked the students to grade their own skill in the following topics: I am able to implement the Freytag's Pyramid, I am able to use relevant graphics in my digital story, I am able to make use of interaction in my digital story, I am able to show a good degree of control of grammatical form, I am able to use an appropriate range of vocabulary and pronunciation, I am able to create an organises story, and I am able to collaborate with my groupmates.

The exit ticket survey consists of twelve questions. This survey asked questions based on their experience during the lesson series. The survey asked questions regarding if they enjoyed the lessons, if they found it to be interesting, if they understood the lessons or if they found it hard to understand, if they improved their English, if they are satisfied with their digital story, what they enjoyed the most and the least, what they found to be the hardest, if they think that creating a digital story helped them with their English and why, if they would want to implement the creation of a digital story into other subjects, and if they had anything else they would like to share.

The CT self-assessment survey consists of ten ordinal questions. It asked the students to grade their own skill in the following topics: I can summarise the most important part of my story, I can create a structured digital story, I can create subtasks while working on the project, I can evaluate my digital story by using the rubric, I can come up with requirements for my digital story, I can improve my digital story if I test my project and remove the mistakes, I can use existing Scratch code from my project to create a digital story in the future, I can help my classmates to improve their digital story, I can divide the subtasks with my group mates, and I can come up with useful ideas for my project.

Next to the surveys, four groups with each group containing three students were interviewed in a way to further understand their answers. This was a semi-structured interview of about ten minutes wherein the students were interviewed in the groups that they worked with during the experiment. This semi-structured interview consists of eleven guiding questions. The topics of these

questions were the attitude of the students towards the lesson series, the experience of the students during the creation of their projects, the evaluation of the students towards the other groups, as well as if the students had any feedback for the researchers.

Next to the interviewing of the students, the researchers also interviewed the teacher. The duration of the interview was about 37 minutes and it consisted of 16 questions. In this interview the teacher was asked about the learning objectives regarding the subject. The teacher was also asked what the standard way of teaching the topic was and how the methods could be compared. In the interview the researchers also asked the teacher about how he experienced this method of teaching the learning objectives.

3.5   Data Analysis

To analyse the data that was collected, the results of the exit ticket, project selfassessment and CT self-assessment were transcribed into an Excel sheet. The thesis made use of frequency to analyse the results of these surveys. The interviews with the four groups as well as the interview with the teacher were also transcribed. This data was analysed by using the steps used in qualitative data analysis. For the interviews with the students the following steps were used. The first step was open coding. The transcribed interviews were carefully read to categories answers from the students per question and then they were labelled. The second step was axial coding. In this step each labelled answer was reviewed and categorised. The last step was selective coding. In this step all the categories from the axial coding steps were connected to one of the research questions. Themes were made to categories the answers given during the interview to make it possible to answer each research question accordingly. These themes are the students' learning outcome related to their English skills, the students' learning outcome related to their CT skills, the attitude of the students, and the attitude of the teacher. The interview questions used in the interview with the teacher was built around the four components of the teacher's pedagogical content knowledge (PCK). These components were used to code the data from this interview.

4   Results

The aim of the research is to see if the integration of CT through digital storytelling with Scratch in the English subject has an influence on how well students perform. This goes for the change in their attitude as well as the performance of their English skills, such as their vocabulary and grammar. This chapter will present all the results from the Scratch projects of the students, the exit tickets, the project self-assessment survey, the CT self-assessment survey and the interviews. The results will be presented in four categories. These four categories are the students' learning outcomes related to their English skills (section 4.1), the students' learning outcomes related to their CT skills (section 4.2), the attitude of the students (section 4.3) and the attitude of the teacher (section 4.4).

4.1   English Learning Outcome of Students

In this section, the students' learning outcomes related to their English skills were evaluated by analysing the content of the digital stories of the students, by evaluating the creative writing of the students, and by a project self-assessment survey which was filled in by the students. The researcher evaluated the creative writing of the students' Scratch projects by using rubric A for evaluating creative writing (Vaezi & Rezaei, 2019).

4.1.1   Content Analyses of the Digital Stories

In the following table the content of each digital story is summarised according to the components of the Freytag's pyramid. The part where foreshadowing is used is also mentioned.

Group 2	
Title	The Babysitter
Exposition	The babysitter enters the house, helps the children with their homework and makes the children ready for bed.
Initial Incident	Instead of going to sleep, the children decide to stay up and spy on the babysitter.
Rising Action	The babysitter invites some friends over and asks for 'the tools'. She also takes a gun from the closet.
Climax	One of the invited friends is tied up and murdered by the babysitter and the children find out about the murder. The children started to run and jump into a car. The children then decide to run over their babysitter with the car.
Falling Action	The babysitter and her friends who murdered someone have been killed.
Resolution	The children wake up and everything has been a dream. Or was it?
Foreshadowing	A gun in the closet.

Group 5

Title	The Street Game - Basketball
Exposition	Two friends are playing basketball on an outdoor basketball court.
Initial Incident	A stranger steals the basketball while the friends were playing.
Rising Action	The stranger tells the friends that they can only have their ball back if they win a game against him.
Climax	The game starts. One of the friends steals the ball back during the game and has to either shoot or dunk to score and win.
Falling Action	The friend scores and wins the game.
Resolution	They can have their basketball back.
Foreshadowing	-

Group 6

Title	Refugee
Exposition	Two creatures are refugees and are looking for a new home.
Initial Incident	The two creatures meet a stranger on the stranger's land and ask the stranger if they can stay on his land.
Rising Action	The stranger refuses, because apparently the creatures have killed his people. The two creatures run to their ship, because the stranger pulls out his weapons. The creatures run to their ship and flee to another planet. When the creatures arrived on a new planet one of the creatures wants to bring his family to the planet while the other creature has a mysterious phone call.
Climax	The creatures' family arrive, but it turns out that the mysterious phone call was the stranger from before and he has plotted to exact his revenge on the creature and his family and decides to kill them all.
Falling Action	In the end it is made clear that everything that has happened was a game.
Resolution	The player lost the game and will try again tomorrow.
Foreshadowing	The phone call with a mysterious person.

Group 7

Title	The Forest
Exposition	Two friends are going to a school camp.
Initial Incident	One of the friends loses their bag.
Rising Action	The two friends start looking for the bag in the forest but end up getting lost. They tried to call someone, but they forgot their phone at the camp. They started to hear noises and decided to run.
Climax	They decided to hide in a cave, but there was a bear in the cave which was making the noises.
Falling Action	-
Resolution	-
Foreshadowing	One of the friends almost forgot his bag before entering the bus, but a neighbour warned him.

Group 8

Title	Pablo and the Princess
Exposition	Pablo and the princess accidentally bump into each other, and Pablo drops his wallet.
Initial Incident	The princess finds the wallet and returns it to Pablo at his house. Pablo invites the princess inside to thank her and watch some television.
Rising Action	Pablo and the princess become good friends and they eventually decide to get married. When Pablo asks the princess to go to the shopping mall and buy a wedding dress, she sees that Pablo is a wanted man on a television screen.
Climax	She comes home and asks Pablo why he never said anything about being a wanted man. Pablo pleads for forgiveness and the princess forgives him.
Falling Action	Pablo and the princess still decided to get married.
Resolution	Pablo and the princess lived a long and happy life.
Foreshadowing	A gun in Pablo's house.

Group 9

Title	The Revenge
Exposition	Two friends decide to go to the movies.
Initial Incident	One of the friends walks the other friend home and goes home by herself.
Rising Action	When she is walking home, she notices something and wonders if she should ignore it or not. The next day the other friend gets a phone call that her friend has been murdered by a serial killer, but then a mouse starts talking to the girl and tells her that he wants to take revenge on the murderer with her help.
Climax	The mouse gives a gun to the friend, and they start heading to the hideout of the serial killer, but the serial killer foresaw that they would come, and they walked right into her trap. The serial killer had planted a bomb and wanted to set it off after she has left the hideout. The mouse wants the friend to throw him at the button to set of the bomb.
Falling Action	The mouse lands on the button and the bomb goes off.
Resolution	The friend was able to get her revenge, but at the cost of her own life.
Foreshadowing	A suspicious woman behind a lamppost and a mouse.

Table 2: Content Analyses of the Digital Stories.

4.1.2 Creative Writing of the Students

To evaluate the Scratch projects of the students related to the students' English learning outcomes, the researcher used a rubric for evaluating creative writing created by Vaezi and Rezaei (2019). This rubric is categorised in nine parts, being: Narrative voice, Characterisation, Mood and Atmosphere, Language and Writing Mechanics, Dialogue, Story, Setting, Image, and Plot. The rubric can be found in the appendix A. For this thesis, the researcher will be looking at the categories:

1. Narrative Voice

2. Characterisation

3. Language and Writing Mechanics

4. Dialogue

5. Story

6. Image

To evaluate the Scratch projects the researcher will grade each category with either excellent (4 points), above average (3 points), developing (2 points) or needs improvement (1 point). The grade will be given by looking at the performance level criteria given by Vaezi and Rezaei (2019).

Category	1	2	3	4	5	6
Project	Grade					
Group 2	3	4	3	4	4	4
Group 5	3	3	3	2	1	3
Group 6	2	2	3	3	4	3
Group 7	2	2	3	3	2	3
Group 8	3	2	3	3	3	3
Group 9	4	3	3	4	3	4

Table 3: Creative Writing of the Students.

Overall, the students were very creative with their stories. Looking at the category 'narrative voice' the difference is quite noticeable. For example, the tone used by group 9 was very realistic, as if the conversations were recorded in real life. Some of the other groups were rather monotone while speaking. The students were also very creative with the category 'characterisation'. For example, group 4 really took the effort to change the facial expressions of the Sprites during the story to fit what was said or what was going on. In some projects this part was lacking. Concerning the category 'language and writing mechanics' all the groups had some small mistakes. A few examples of the mistakes are using the word 'that' instead of 'those', writing goodmorning without a space in between and punctuation errors. The category 'dialogue' was overall well done by the groups.

The conversations during the sprites were easy to follow and contributed to the stories. For the category 'story' the researcher focused on the use of the Freytag's pyramid as well as foreshadowing. The foreshadowing objects were very clear in the stories, but in a few stories the ending was very sudden. It was also noticeable that not all the stories had a part where all the loose ends were tied up, which is an element of the Freytag's pyramid. Lastly for the category 'images' the stories all had fitting backgrounds and characters to better understand the story.

4.1.3 Students' self-assessment

The self-assessment consists of seven ordinal questions in which the students can share their opinion on how well they are doing in the different elements within the project. The project self-assessment is asking the students to evaluate themselves by dividing the project in seven categories. The first category is the structure of their story in which the students had to make use of the Freytag's Pyramid. The next category is the graphics of their digital story. This category is focused on the support of the scenes with the story. The following category is programming. In this category the students are asked about the interaction within their story as well as there being no bugs. The next category is about the English grammar used in their digital story. Next to this category is the pronunciation and vocabulary category in which the students are evaluating if they used an appropriate range of vocabulary while pronouncing the words well. The following two categories are organisation and collaboration. These categories are there so that the students can evaluate if their storyline is well organised and flows smoothly and if their collaboration was in order and if all the team members participated within their project. All questions had four possible answers. Emerging, developing, proficient and advanced. These answers were more elaborated for every category.
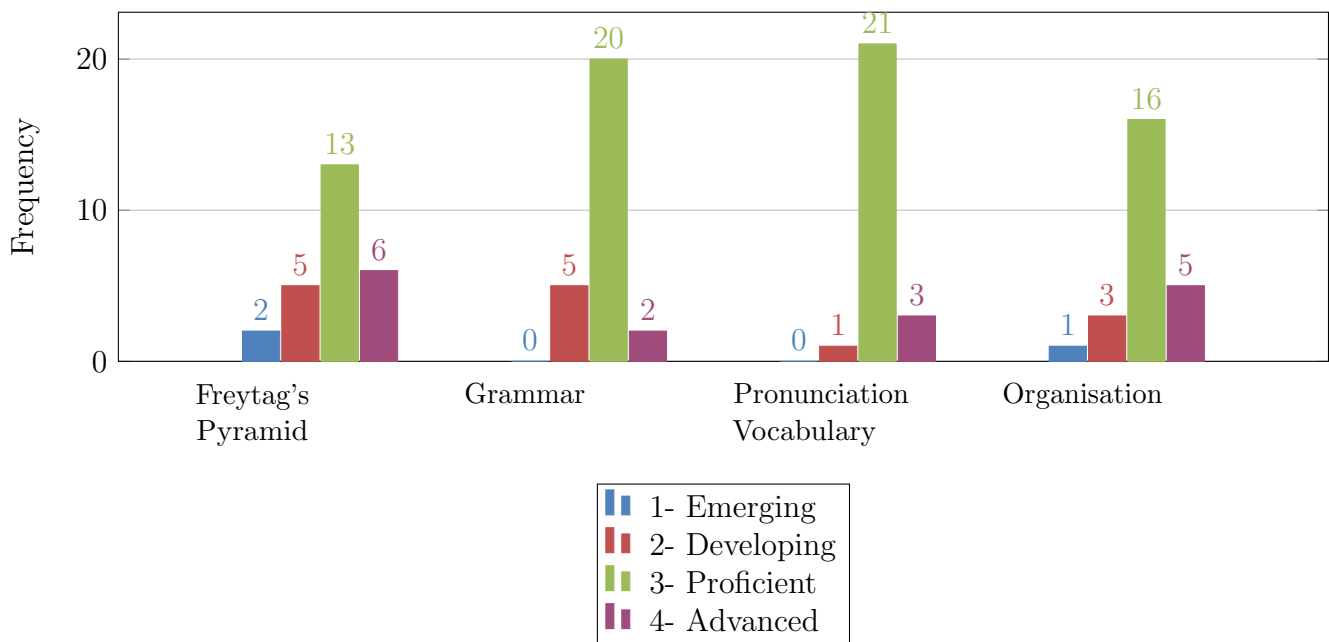

Figure 3: Project self-assessment questions related to the development of the students' English skills.

Looking at the development of the English skill of the students, four of the seven questions from the project self-assessment survey will be used. Question number ten from the exit ticket which asked the students if they think that creating a digital story helped them to learn English better, will also be used. 27 students have filled in the project self-assessment survey.

28 students answered question number ten from the exit ticket concerning if creating a digital story helped the students to learn English better. 23 students answered with no. Some of the reasons why are because they used words that they already know. Others said that they did not, because they consider themselves already very fluent with the English language. Four students answered with yes and some of the reasons why are that they could work on their vocabulary and that they had a lot of practice with speaking. During the interviews a group mentioned that working on their digital story did not really help with their grammar, but it helped with their pronunciation. Another group mentioned that it did not really help their grammar and vocabulary, because they can use the words that they already know, but that it did help their pronunciation because they mentioned that they do not practise speaking with each other too often.

4.2 CT Learning Outcome of Students

The students' learning outcomes related to their CT skills can be categorised by a few of the components of CT being abstraction, decomposition, evaluation, generalisation and collaboration. The result for each component comes from the CT self-assessment survey which consists of ordinal questions. The possible answers are:

1. I do not quite understand it yet.

2. I know what it means, but I cannot do it yet.

3. I doubt if I am able to do it.

4. I can do it.

5. I can do it and explain it.

The interviews with the groups were also used for the results.

4.2.1 Abstraction

For the component abstraction the students should be able to separate the important information from the redundant information while writing the story. This is done by the students mainly during the filling in of their storyboard, in which the students had to write their story according to the Freytag's Pyramid. The students had to think about all the elements, such as the topic, sub-themes, foreshadowing and the important details they want and need in their story before they started writing it. In the CT self-assessment survey, the following two questions were asked concerning abstraction.

		Answer					
		1	2	3	4	5	Total
				Frequency			
Questions	I can summarise the most important part of my digital story.	0	1	3	6	14	24
	I can create a digital story with a beginning, middle and end.	1	5	3	8	9	26

Table 4: Questions about the CT component abstraction.

In figure 4 and figure 5 we see an example of how this group used their plan from their storyboard and placed it in their digital story.

1.scene: _plannig for tomorrow to bios. (Foreshadowing killer) and mouse_

2.scene: _byel, byel (mouse in the corner) killer behind the bushes._

3.scene: _excited for tomorrow (zoom into the mouse home.) lightswitch goes off_

4.scene: _Close up to mouse and is home. (Who is she?)_

5.scene: _Grand gets a call from the police: thor_

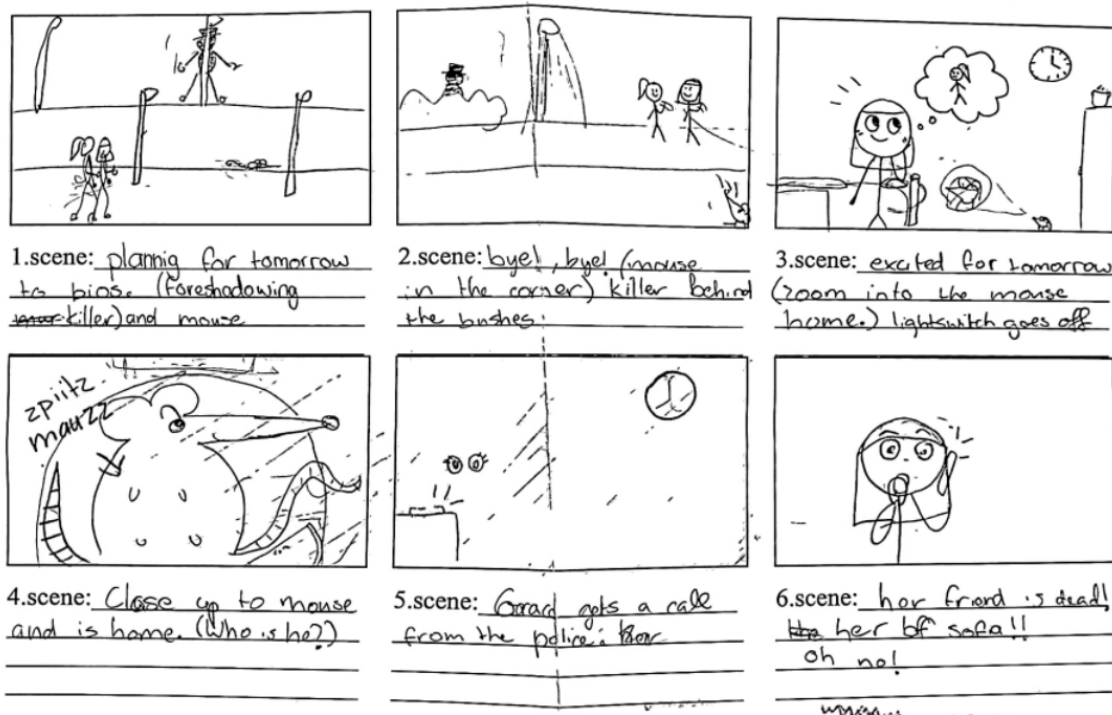6.scene: _hor frierd is dead! the her bf sofa!! oh no!_

Figure 4: Storyboard example from group 9.

Figure 5: Scratch example from group 9.

4.2.2 Decomposition

The component decomposition is all about the skill to divide a larger and more complex task into a number of sub-tasks which can be worked on separately. When the students were working on their storyboard, they also had to think about the Scratch which consists of the audio, the text, the backgrounds, the sprites, the interaction and so on. The students also needed to decompose how they would implement the Freytag's Pyramid within their storyline as well as how and when to use foreshadowing. In the CT self-assessment survey, the question was asked: I can divide complex tasks from my digital story into subtasks. 26 students answered this question with 15 students saying that they are capable of doing so and five students out of the 15 that said that they have this skill also mentioned that they are able to explain it as well. 10 of the students were in doubt whether they were able to divide the complex task into subtasks and one student did not understand it yet.

		Answer					
		1	2	3	4	5	Total
		Frequency					
Questions	I can summarise the most important part of my digital story.	1	0	10	10	5	26

Table 5: Question about the CT component decomposition.

4.2.3 Evaluation

The students should also have the skill to evaluate their project. With this skill the students should be able to criticise their own work and name points of improvement, but also name parts that went well or better than before. The students evaluated their work mostly at the end of the experiment, but even during the making of their digital story, the students were working on correcting and editing their work. The question was asked: I can take a critical look at my digital story and compare it to the requirements of the rubric. 25 students answered this question. Five students said that they have this skill and can also explain it. 10 students said that they have the skill but are not able to explain it. Eight students were in doubt, one student said that he or she does not possess this skill and one student did not understand it yet. The following two questions were also about the skill evaluation.

		Answer					
		1	2	3	4	5	Total
		Frequency					
Questions	I can think of additional requirements that my digital story should meet.	0	3	4	12	7	26
	I can explain that my digital story gets better when I test my story and remove the errors.	0	2	2	12	10	26

Table 6: Questions about the CT component evaluation.

During the interviews the groups were asked to evaluate the projects of the other groups and mention what they noticed. Group five mentioned that they could see that a lot of groups really did work hard on their project. They did mention that they would like some more improvements on the pronunciation of the other groups. The things that made a good story for them was a good storyline with good structure. If a story lacked this and is hard to follow, it would be a bad story. Group eight mentioned that they wanted to see more interaction of the Sprites in the stories of the other groups. For them a good story had to be creative and would need to have a sufficient amount of interaction with the backgrounds and characters. Group nine mentioned that some stories ended unexpectedly and that they could not see the storyline clearly.

4.2.4 Generalisation

With generalisation the thesis looks at the students' abilities to identify patterns and commonalities in their project and being able to reuse these parts in their project. The question was asked: I can use existing parts of my Scratch code to create new stories in the future. 26 students answered this question.

		Answer						
		1	2	3	4	5		Total
				Frequency				
Questions	I can use existing parts of my Scratch code to create new stories in the future.	3	4	6	8	5		26

<div align="center">Table 7: Question about the CT component generalisation.</div>

4.2.5 Collaboration

Lastly the thesis looks at the ability to cooperate with their group mates. The thesis mainly looks at the dividing of the workload and the attitude of the students towards each other. This started the first day when the students had to divide the tasks. Even with the tasks divided the students still had to collaborate with the recording of their voices and the giving of feedback to their group mates. The following questions were asked for the students to rate their collaboration skills.

		Answer						
		1	2	3	4	5		Total
				Frequency				
Questions	I can help my classmates to improve their digital story	1	4	9	7	4		25
	I can divide the sub-tasks with my group members.	1	0	5	12	7		25
	I can contribute useful ideas to my group.	1	0	3	8	13		25

<div align="center">Table 8: Questions about the CT component collaboration.</div>

During an interview a group mentioned that they felt that their collaboration was good. They were able to keep each other in check when one member would be slacking off and had no difficulties asking each other for help. Another group mentioned that they were able to divide the tasks in the beginning of their project and that every member finished their task. This group also mentioned that they would also look for parts in the tasks of their group members that could be improved whilst being busy with their own task. Another group mentioned that they started with dividing the tasks, but that when the project started, they did away with these roles and started working on each part together. A group also mentioned that they have improved their collaboration skills. They mentioned that they better understand how to deal with group members during a group project.

4.2.6 CT Learning Outcome Summary

To sum the CT self-assessment survey up, the average of the scores that every student gave themselves per component of their CT skills will be displayed in the diagram below.
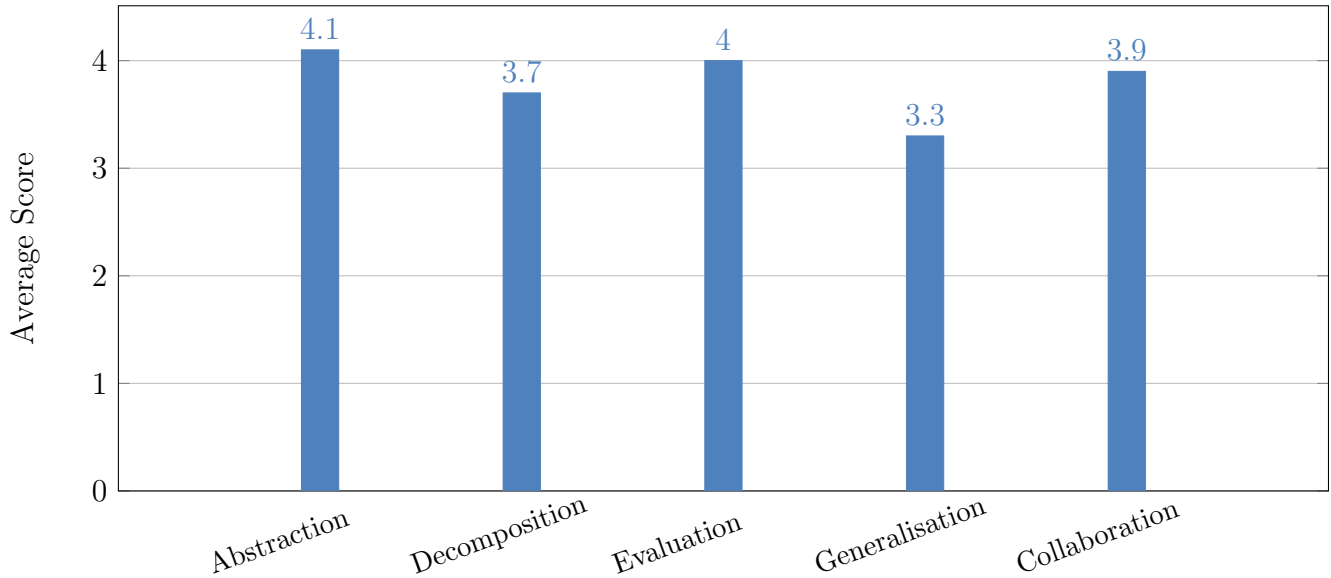
Figure 6: Average score of the CT self-assessment survey per component.

4.3   Attitude of the Students

The results of the attitude of the students can mainly be found in the exit tickets. The interviews with the students' feedback are also found in this section.

4.3.1   Opinion About the Lessons

The exit ticket consists of twelve questions in total. The first five questions are ordinal scale questions in which the students have to choose between the options: yes, uncertain or no. Out of the 29 students that participated in the case-study 28 filled in the exit ticket. In the exit ticket the last seven questions are open questions. These questions are focussed on their experience during their project.
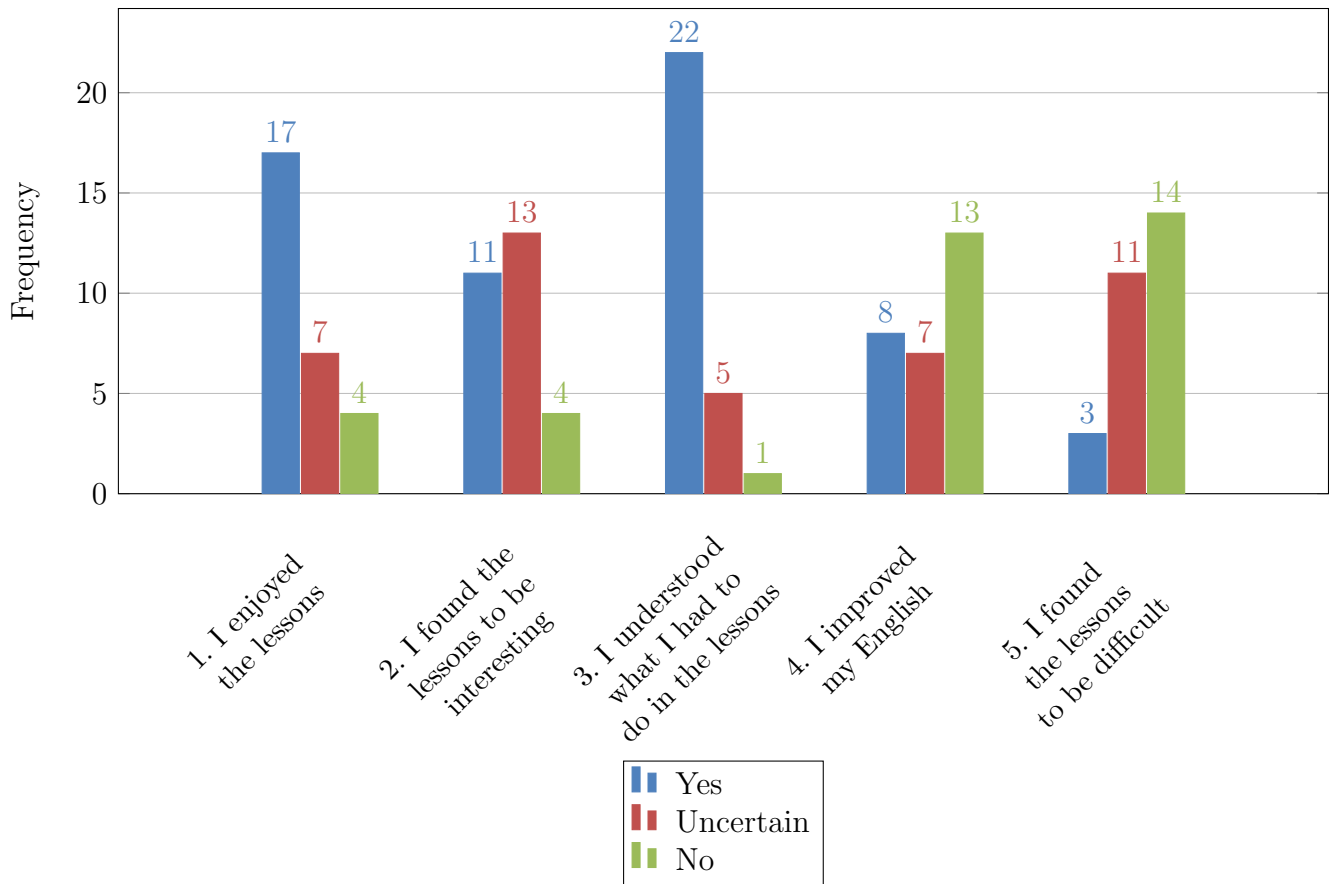
Figure 7: First five questions of the exit ticket.

Three open questions from the exit ticket asked are about what the students enjoyed the most and what the students enjoyed the least about the lessons as well as what the students found to be the hardest about the lessons. Out of the 27 students that answered the question about which part of the project they enjoyed the most, four students mentioned that they enjoyed the collaboration the most. Six students mentioned that they enjoyed creating their script the most. Two students mentioned that they enjoyed the programming part the most and one student also mentioned that the way of learning that was applied was the most enjoyable part. During the interviews a group mentioned that they liked the way of learning, because it was different and that they prefer this way of learning over learning by just using books. Another group mentioned that they really liked the experience they had with the recording of their voice overs. They also mentioned that they really liked the freedom that was given to them with the way their story should be. For the question: which part of the project the students enjoyed the least, seven students mentioned that they disliked the coding part, mainly because of the amount of time it took. Three students mentioned that they did not like the part where they had to create their script. During the interview a group mentioned that they disliked the part of the weight of the grade. They mentioned that it applied a lot of pressure on them. Out of the 26 students that answered the question which part of the project they found to be the hardest, 14 students mentioned something related to programming. A student also shared that this way of learning was a fun and interesting experience. In the interviews all the groups mentioned that they faced some difficulties with the Scratch environment. All the students chose to work with Scratch as the programming language. Group number eight first preferred to work with Python, but after they heard the requirements for the assignment, they changed their minds.

4.3.2 Attitude Towards the End Product

The first open question asks the students if they are satisfied with their digital story. 26 students answered this question. 18 students shared that they are indeed satisfied with their digital stories. Recurring reasons for this are that they enjoyed their story, because according to them it was creative. Six students shared that they were not satisfied with their digital story with the main reason being that they were not able to finish their project in time. In an interview a student mentioned that he/she was satisfied with his/her story, but that he/she wanted to expand the story more. The reason that they were not able to do so according to the group was because of the lack of time they had left. Another group mentioned that they would have wanted to improve their voice recordings, but that apart from that everything went as planned.

4.3.3 Future Research Recommendation of the Students

For the question if the students recommend the implementation of CT through digital storytelling for other school subjects, the subject French was mentioned twice while the subjects German, Dutch, Geography, Mathematics and Art were all mentioned once. During the interviews a group mentioned that the implementation of CT through digital storytelling would be interesting for the subjects History or Geography, because according to them you would remember the story and names better and it would help them to memorise the dates of historical events. Another group mentioned German and French, because they said that these languages are harder than English, so it would be a bigger challenged to learn the words and grammar.

4.3.4 Feedback from the Students for the Improvement of the Lesson Series

During an interview one group mentioned that in the future they would like more assistance with planning what part of the project should be done when. They mentioned that a guideline could be presented to the students so that they can have a rough idea how far they should be and what would be expected of them. Another group mentioned that they would like to get some feedback during the experiment and not only at the end of it all. Another group mentioned that they would like to have more time the next time that they would have such a big assignment. When asked how the students would compare last year's project with this year's project a group mentioned that they thought that this year's project was more challenging because of the freedom that was given in the creation of a story instead of just introducing yourself. Another group mentioned that they liked the creativity in the interaction with the characters of this year's project better than last year's project. Another group mentioned that in their project of the year before they would immediately work in Scratch instead of working on their script first, indicating that they worked with more structure during this year's project.

4.4 Attitude of the Teacher

The results from the attitude of the teacher comes from the interview held by the researchers. This interview was held after the experiment was finished. The themes that were discussed during the interview are the learning objectives regarding the English subject and regarding CT, the way the learning objectives have been taught to the students through instructional strategies, the understanding of the students according to the teacher and the assessment strategies that were used by the teacher throughout the experiment. These themes are components of the PCK, which have been introduced by Shulman (1986). The components have been added by Magnusson et al. (1999).

4.4.1 Learning Objectives

For the component learning objective, the goal is to find out what the teacher would like to teach the students. This concerns the English subject as well as the CT skills. During the interview the question was asked what the learning objectives were for the students regarding the English subject. The teacher mentioned that one of the learning objectives was for the students to understand how the Freytag's pyramid works and to better grasp how a story is built. Another learning objective was for the students to make use of foreshadowing in their story. The teacher also mentioned: "kids consume a lot nowadays, but they do not produce a lot, and this was like. . . it really put them more on the producing side of things." When the question was asked if the teacher thought if the learning objectives were successfully taught the teacher said that he does think so. He mentioned that the foundation has now been laid and that he can build on it more. The teacher also mentioned that the Freytag's pyramid is often taught in the fifth or sixth year and that through this experiment a simple way of teaching this learning objective has been applied.

4.4.2 Instructional Strategies

For the component instructional strategies, the thesis looks at the strategies used to obtain the learning objectives, as well as compares them to the way the teacher would have obtained

these learning objectives without the integration of CT. Concerning the instructions the teacher mentioned the following: "Specifically I think we were being very clear with them in terms of instructions, being clear with them what they have to do and setting clear goals for them. But also creating boundaries for them to work within. So, to me the most important thing was that it was clear for them what they have to do, but also what they do not have to do. But also, within that space give them the freedom to be creative." The teacher also said that the strategy was project based. When asked to compare the way of teaching the topic through digital storytelling and how the teacher would normally teach this topic the teacher mentioned the following: "What we would probably do is: just tell them about it and maybe have them recognize it. So, if you talk specifically about the Freytag's pyramid, you would have to explain it to them and tell them to go figure out: Where is the climax in the story? Where is the exposition in the story? Right? So, they did an extra step where they had to create it. So that was different from how we would do it. This is a different way; I cannot recall us telling them to create their own story. So, I think this was a different way and it probably is going to stick more because when you produce something it tends to go into your long-term memory. So, I think this was a stronger assignment, I guess."

4.4.3 View of the Students' Understanding

For the component, view of the students' understanding, the goal was to find out what the teacher's perspective is concerning the understanding of the students. The thesis is interested in the students' attitude from the teacher's point of view. When the question was asked what the teacher's observation of the students was from the students' perspective, how the students' reactions were and what the teacher thought that the students found easy or difficult and liked or disliked, the teacher mentioned the following: "I think, in general... The issues that you have in all types of projects, so it was not like an issue specific to this project, those are things that you can expect. But I thought they liked it. They were really creative with it, I thought. So, what I have got back from them is that they enjoyed it. It was not like "Hey, this is grammar and listen!", but it was more. I think the creative part, that is what they liked the most about it."

4.4.4 Assessment Strategies

For the evaluation component, the thesis looks for what the teacher thought about the experiment of the integration of CT, as well as how the teacher evaluated the students' work. The question was asked how the teacher evaluated the students' achievements, what type of strategies the teacher used and how the teacher evaluates success in the integrated lessons. First the teacher mentioned the things that he saw during the presentations of the end results of the students. He mentioned that from what he saw that the students understood the assignment and that the students executed what they wanted to do. The teacher also mentioned that he makes use of a rubric which consists of four skills: reading, writing, listening and speaking. The teacher mentioned that evaluating reading and listening is very accurate, because it is tested with multiple choice exams, but when it comes to evaluating writing and speaking, it becomes more subjective and this is where the teacher uses a rubric. The teacher also mentioned that the students usually do not get a lot of writing and speaking of the English language in the second year, so the use of the rubric in the second year was also a new thing for him. The teacher also mentioned the following: "what we took from it, is that we are going to try to incorporate more of these types of assignments for

them, because then you are really busy with the language." When it came to the evaluation of the practice of speaking of the students the teacher mentioned that through creating the digital stories, the students would be more relaxed with the recording of their voices than if the students' practice of speaking and pronunciation were evaluated based on a live presentation. The reason the teacher gave for this is that it is not live, and you can evaluate and work on your recordings by doing them over.

When the teacher was asked if there were aspects that could be improved in the design or implementation of the lesson series, the teacher mentioned that in the future he would like to have more options for students who are already very good at the programming part. Because some students had to figure out how Scratch works while creating their digital stories, others already knew the ins and out of Scratch. The teacher wanted the possibilities to be enlisted before the start of the experiment so that he can know how far he can push and encourage students who are already well known with the programming part. The teacher also mentioned that he would like for there to be an example, like a model of what the students can aim for as well as evaluation stops during the experiment so the students can see if they are on the right track. The teacher even suggested that the students could gain points toward their grade during the experiment.

Next the question was asked how the students learned compared to last year's lessons and what the differences were for the teacher as well as the students. The teacher mentioned that he thinks that this year's assignment connected better with CT. The teacher also mentioned that because this year's assignment was more specific than last year's assignment, the assessment was clearer for the teacher.

After this, the question was asked if the teacher would be open to integrate CT in his future lessons. The teacher said yes and mentioned that unlike mathematics, which is pretty much fixed, the theories used for teaching a language change over time. The teacher also mentioned that this way of learning helps the students with communication and thinking about their steps.

5 Conclusions and Discussion

The aim of the thesis was to find out if there are benefits of integrating CT into the Dutch school curriculum with English being the subject. To help answer this question, four research questions were established. This chapter will conclude and discuss the findings of the study with the literature (section 5.1), share the limitations of the study (section 5.2), and share recommendations for future studies (section 5.3).

5.1 Conclusion and Discussion

5.1.1 English Learning Outcome of Students

The first research question is: "What is the influence of the integration of CT through digital storytelling on the students' learning outcome related to their English skills?"

From the results concerning the analysed digital stories, it is clear that the students were able to be very creative in writing their story. Concerning the creative writing of the students, it is clear that the students understood the assignment, even though some stories were better in fulfilling all the requirements than others. Looking at the grammar, vocabulary, pronunciation and punctuation the thesis shows that only a small number of mistakes were made.

From the results concerning the students' learning outcome related to their English skills gathered through the surveys filled in by the students and interviews done with the students, the thesis shows that the majority of the students do not think that their English skills have improved in the process of creating a digital story. Some students mentioned that they improved their pronunciation, because of the recording of their voice overs, but that their grammar and vocabulary has not improved, because they were allowed to create their own script using their own and familiar words.

Looking at the literature mentioned in the literature review which states that "Students who take part in the development of digital stories can improve their communication skills by learning to express themselves, ask important questions, share their perspectives, and create narratives, as all of these help sharpen students' speaking skills." (Nair & Yunus, 2021, pp. 12-13) it is clear that it shows the same results. Even though not all students saw the benefits concerning the development of the students' English skills, students mentioned that they normally do not practice speaking English that often.

5.1.2 CT Learning outcome of Students

The second research question is: "What is the influence of the integration of CT through digital storytelling on the students' learning outcome related to their CT skills?"

From the results concerning the students' learning outcome related to their CT skills, the thesis shows that the students reflected their understanding of the components of CT and came to the conclusion that they understand it very well. For example, it is clear that the students understood abstraction when looking at the transition from the storyboards to the digital stories. Plans were made with the essential information to create a story with all the elements in it. The students also showed that they can evaluate their own and other students' projects. They shared what a good digital story is and what it needs. The students also worked with computing concepts

like variables, conditionals, and Boolean Logic for their interaction part in their digital story. Furthermore, the students also shared that they improved their collaboration skills throughout the project.

5.1.3 Attitude of the students

The third research question is: "What attitude do the students have towards the CT integrated lessons through digital storytelling?"

From the results concerning the attitude of the students, the thesis shows that most of the students enjoyed the lessons. Almost all the students understood what they had to do and most of the students did not find the lessons difficult. The students shared that they liked this way of learning, because it is something else than learning from books as they usually do. Almost half of the students had some sort of difficulty related to the programming of the digital story. Also a few students mentioned that they felt a lot of pressure because of the weight of the grade of the assignment. The students also recommended this way of learning for other school subjects, like other languages or even History, Art or Mathematics. The students also shared their feedback. They mentioned that they liked the structure of the project. Some students mentioned that they would like to see a guideline of what needs to be finished when and others mentioned that they would want to have more time. This indicated that the students could benefit from more help with planning in the future.

In the literature review it is said that: "...CT and Scratch increase curiosity, interest, and interaction between students, which can lead to increases in their learning motivation in regard to the English language." (Parsazadeh et al., 2020). This goes in line with what the students said about liking another way of learning compared to learning from books.

5.1.4 Attitude of the teacher

The fourth research question is: "What attitude does the teacher have towards the CT integrated lessons through digital storytelling?"

From the results concerning the attitude of the teacher, the thesis shows that the learning objectives from the teacher, which were the understanding of the Freytag's pyramid as well as the understanding of foreshadowing, have been taught successfully. The teacher mentioned that the foundation has been laid and that a simple way of teaching these subjects has been applied successfully. Compared to how the learning objectives would normally be taught, the teacher mentioned that through the creation of a digital story he thinks that the subject is going into the students' long-term memory, because it was an active and big project. The teacher's view of the students' understanding, and attitude is that he thinks that the students liked it. The teacher mentioned that the students were really creative with their work and that he thinks that this is what the students enjoyed the most. The teacher also mentioned that he thinks that the students understood the assignment and executed what they wanted to do. The teacher also mentioned that he wants to incorporate more of these projects, because by doing so students will be more active with the language. He also thinks that through creating digital stories, students are more relaxed than if they had to do a presentation in front of the class. Furthermore, the teacher mentioned that he would be open for the integration of CT in his future lessons, because it helps the students with their communication and helps the students to think about the steps that they make.

5.2   Limitations

During the study, the researchers faced a few limitations. First, the surveys were filled in with pen and paper, so not every question was answered by each student and not every answer was readable by the researchers. Second, for one of the lessons it was hard to find a computer lab, so the students had to work on a single laptop per group which limited the progress that could have been made. Third, the duration of how long the students could really work on their digital stories was rather short, which shortened the amount of time the students had to evaluate their work or their peers' work. In addition to this for one of the lessons the students were very late, because of the students' previous lesson. This caused the students to miss out on thirty minutes of a lesson. Finally, the sample size of the group was not large enough to generalise the conclusions made from the thesis with the whole school or all the schools in the Netherlands.

5.3   Recommendation for Future studies

Future studies concerning the integration of CT through digital storytelling could benefit from a larger sample size with different schools participating in the project. An increase of the time period of the project could also help with analysing all the components. The method used can also be implemented for other school subjects. The teacher mentioned that he would like to know what the possibilities and limitations are for the project with regard to the programming of the digital story, so that he can encourage the students that do not find the project to be challenging enough by asking them to add harder features. This could also be implemented in future studies.

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A Rubric for evaluating creative writing

Performance levels criteria		Excellent 4 pts.	Above average 3 pts.	Developing 2 pts.	Needs improvement 1 pt.
1. Narrative voice	1.1	An original voice is created through maximal use of rich and flexible language and vocabulary which are appropriate to the situations, events, actions, and emotions that the writer wants to express and the overall meaning of the story.	An original voice is created through several uses of rich and flexible language and vocabulary which are appropriate to the situations, events, actions, and emotions that the writer wants to express and the overall meaning of the story.	Voice is created through minimal use of rich and flexible language and vocabulary which are appropriate to the situations, events, actions, and emotions that the writer wants to express and the overall meaning of the story.	Voice is created through the use of poor language and vocabulary which are not appropriate to the situations, events, and actions that the writer wants to express and the overall meaning of the story.
	1.2	Specific details that contribute to the creation of an authentic, consistent, and believable world of story are used to a maximum level.	Specific details that contribute to the creation of an authentic, consistent, and believable world of story are used to an acceptable level.	Specific details that contribute to the creation of an authentic, consistent, and believable world of story are used to a minimum level.	World of story is presented as inconsistent and unbelievable through no or improper use of details.

	1.3	Point of view is completely clear, totally consistent, and entirely appropriate to the genre attempted. Any shift in the point of view of the story is totally justifiable by artistic reasons.	Point of view is consistent, clear, and appropriate to the genre attempted If more than one point of view is used this is mostly justifiable by artistic reasons.	Point of view is often inconsistent, unclear, and inappropriate to the genre attempted. If more than one point of view is used, this appears to be mostly arbitrary and unjustifiable by artistic reasons.	Point of view is completely unclear, totally inconsistent, and entirely inappropriate to the genre attempted. Shifts in the point of view of the story are not caused by artistic reasons and seem to be totally arbitrary.
2. Characterisation	2.1	Characters are often revealed indirectly through their physical appearance, action, thought, dialogue, setting, and symbol.	Characters are sometimes revealed indirectly through their physical appearance, action, thought, dialogue, setting, and symbol.	Readers are often directly told what a character is like with little explanation of characters' thoughts and actions, or use of dialogues, etc. to reveal the characters.	Readers are directly told what a character is like with no explanation of characters' thoughts and actions, or use of dialogues, etc. to reveal the characters.
	2.2	Characters' actions, thoughts and dialogues contribute to the meaning of the story to a maximum level.	Characters' actions, thoughts and dialogues contribute to the meaning of the story to an acceptable level.	Characters' actions, thoughts and dialogues contribute to the meaning of the story to a minimum level. Story often feels forced and the actions of the characters illogical.	Characters' actions, thoughts and dialogues pay no contribution to the meaning of the story. Characters are not fully developed enough for the story to feel logical.

2.3	If characters undergo change as the result of the events in the story, the character development always seems probable and realistic due to the provision of sufficient time and evidence in the story.	If characters undergo change as the result of the events in the story, the character development often seems probable and realistic due to the provision of time and evidence to an acceptable level in the story.	If characters undergo change as the result of the events in the story the character development rarely seems probable and realistic due to the provision of time and evidence to a minimum level in the story.	If characters undergo change as the result of the events in the story, the character development seems improbable, illogical and unrealistic due to the provision of insufficient time and evidence in the story.
3.1	Characters' actions, thoughts and dialogues, as well as the events and settings in the story are always presented through the use of appropriate language and vocabulary which contribute to the establishment of the intended mood and atmosphere.	Characters' actions, thoughts and dialogues, as well as the events and settings in the story are often presented through the use of language and vocabulary which contribute to the establishment of the intended mood and atmosphere.	Characters' actions, thoughts and dialogues, as well as the events and settings in the story are rarely presented through the use of language and vocabulary which contribute to the establishment of the intended mood and atmosphere.	Characters' actions, thoughts and dialogues, as well as the events and settings in the story are presented through the use of inappropriate language and vocabulary which pay no contribution to the establishment of the intended mood and atmosphere.

4. Language and Writing Mechanics	4.1	Rules for punctuation, capitalisation, spelling and grammar are observed by the writer to a maximum level and no grammatical, punctuation, and spelling errors exist in the student work.	Few grammatical, punctuation, and spelling errors exist in the student work.	Some grammatical, punctuation, and spelling errors exist in the student work.	Rules for punctuation, capitalisation, spelling and grammar are observed by the writer to a minimum level and many grammatical, punctuation, and spelling errors exist in the student work.
5. Dialogue	5.1	Dialogues help to establish characters, introduce tension, create scenes, and direct actions and events in the story to a maximum level.	Dialogues help to establish characters, introduce tension, create scenes, and direct actions and events in the story to an acceptable level.	Dialogues help to establish characters, introduce tension, create scenes, and direct actions and events in the story to a minimum level.	Dialogues are never used to establish characters, introduce tension, create scenes, and direct actions and events in the story and only act as a filler to decorate the story.
	5.2	Dialogues are in congruency with the mental characteristics and social status of the characters to a maximum level.	Dialogues are in congruency with the mental characteristics and social status of the characters to an acceptable level.	Dialogues are in congruency with the mental characteristics and social status of the characters to a minimum level.	Dialogues are totally incongruent with the mental characteristics and social status of the characters.

6. Story					
	6.1	A preliminary account of the characters and settings, dialogue, brief summary, a reference or a detail is always presented before the introduction of any sort of conflict.	A preliminary account of the characters and settings, dialogue, brief summary, a reference or a detail is often presented before the introduction of any sort of conflict.	A preliminary account of the characters and settings, dialogue, brief summary, a reference or a detail is rarely presented before the introduction of any sort of conflict.	No preliminary account of the characters and settings, dialogue, summary, reference or detail is used before the introduction of any sort of conflict.
	6.2	Techniques of revealing time in fiction (scene and summary) are always used appropriately.	Techniques of revealing time in fiction (scene and summary) are often used appropriately.	Techniques of revealing time in fiction (scene and summary) are rarely used appropriately.	Techniques of revealing time in fiction (scene and summary) are never used appropriately.
	6.3	Confrontation and change, patterns of connection and disconnection, and trouble and effort to overcome it are presented to a maximum level in the story.	Confrontation and change, patterns of connection and disconnection, and trouble and effort to overcome it are presented to an acceptable level in the story.	Confrontation and change, patterns of connection and disconnection, and trouble and effort to overcome it are presented to a minimum level in the story.	No confrontation and change, pattern of connection and disconnection, or trouble and effort to overcome it are presented in the story.
	6.4	Confrontation and change in the story are mostly presented through scenes rather than summaries.	Confrontation and change in the story are presented equally through scenes and summaries.	Confrontation and change in the story are presented through a brief description of the situation.	Confrontation and change are presented in the story very briefly with no description of the situation.
	6.5	Purpose of the story is conveyed implicitly with no use of formal statements.	Purpose of the story is mostly conveyed implicitly with minimal use of the formal statements.	Purpose of the story is mostly conveyed explicitly with maximal use of the formal statements.	Purpose of the story is totally conveyed explicitly through the use of formal statements.

7. Setting	7.1	Setting presents both information and emotion, conveys mood, and signals change to a maximum level with a proper consideration of the purpose of the story.	Setting presents both information and emotion, conveys mood, and signals change to an acceptable level with a somewhat proper consideration of the purpose of the story.	Setting presents information and emotion, conveys mood, and signals change to a minimum level with an improper consideration of the purpose of the story.	Setting does not present information and emotion, convey mood and signal change or if any information, emotion, or change is conveyed through setting, it is totally incongruent with the purpose of the story.
	7.2	Setting has an effect on the actions and events in the story, behaviours of the characters, or the general outcome of the story to a maximum level.	Setting has an effect on the actions and events in the story, behaviours of the characters, or the general outcome of the story to an acceptable level.	Setting has an effect on the actions and events in the story, behaviours of the characters, or the general outcome of the story to a minimum level.	Setting has no effect on the actions and events in the story, behaviours of the characters, or the general outcome of the story.
	7.3	Variety and involvement are created in the story to a maximum level due to the proper use of long, middle and close perspectives to describe the setting.	Variety and involvement are created in the story to an acceptable level due to the somewhat proper use of long, middle, and close perspectives to describe the setting.	Variety and involvement are created in the story to a minimum level due to the minimal use of long, middle, and close perspectives properly to describe the setting.	No variety and involvement are created in the story due to the improper use of long, middle and close perspectives to describe the setting.

8. Image	8.1	Concrete and significant details that appeal to senses and suggest ideas beyond the surface are used to a maximum level in the story.	Concrete and significant details that appeal to senses and suggest ideas beyond the surface are used to an acceptable level in the story.	Concrete and significant details that appeal to senses and suggest ideas beyond the surface are used to a minimum level in the story.	Concrete and significant details that appeal to senses and suggest ideas beyond the surface are not used in the story.
9. Plot	9.1	The plot of the story has an artistic unity. Actions, events, and scenes are arranged in a logical order and irrelevant items which pay no contribution to the advancement of plot are not included.	Actions, events, and scenes are arranged in a reasonable order and a few irrelevant items which pay no contribution to the advancement of plot are included.	Actions, events, and scenes are arranged in a somewhat reasonable order and some irrelevant items which pay no contribution to the advancement of plot are included.	Actions, events, and scenes are arranged in an illogical order and a large number of irrelevant items which pay no contribution to the advancement of plot are included.
	9.2	Actions, events, and scenes are put together in a way that the causal relationships among them are meaningful to a maximum level.	Actions, events, and scenes are put together in a way that the causal relationships among them are meaningful to an acceptable level.	Actions, events, and scenes are put together in a way that the causal relationships among them are meaningful to a minimum level.	There are not any meaningful causal relationships between actions, events, and scenes in the story.
	9.3	Each turn in the plot is justified by the characters and situations to a maximum level.	Each turn in the plot is justified by the characters and situations to an acceptable level.	Each turn in the plot is justified by the characters and situations to a minimum level.	There is no justification for turns and shifts in the plot.