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Investigating Emergent Dynamicity and Development of Complexity and Accuracy in Writing of Norwegian L2 Learners of English: A Complex Dynamic Systems Theory Perspective

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Sammendrag

Ved å ta i bruk det teoretiske rammeverket Complex Dynamic System Theory (CDST), utforsker denne longitudinelle kvantitative studien den fremvoksende dynamikken og utviklingen av kompleksitet og nøyaktighet i skriving av åtte norske L2-elever i engelsk. Undersøkelsen er utført ved en nøye undersøkelse av både den individuelle utviklingen av kompleksitets- og nøyaktighetskonstruksjonene for hver deltaker og interaksjonene mellom de to konstruksjonene over en treårsperiode. Deretter fokuserer denne oppgaven på to forskningsspørsmål: 1. Hvordan utvikler norske ungdomsskoleelevers skriftlige arbeid seg med tanke på kompleksitet og nøyaktighet over en treårsperiode? og 2. Hvordan påvirker parameterne kompleksitet og nøyaktighet hverandre over en treårig observasjonsperiode?

Ti tekstprøver med en lengde på 200 ord hver (±10%) ble hentet ut fra ti eksempeltekster samlet fra hver enkelt deltaker og analysert ved å bruke deskriptive mål som frekvenstelling for å måle setningstyper og feiltyper og forholdsanalyser som Word/Finite Verb ratio and Error-Free Clause/Clause ratio.

Videre brukte vi en korrelasjonsanalyse for å undersøke interaksjonen mellom de to konstruksjonene. De overordnede funnene i denne masteroppgaven er at deltakerne skildre ikke-lineær atferd og en høy grad av variabilitet som uten tvil demonstrerer noen av hovedkarakteristikkene til et Complex Dynamic System Theory. Studien viser også at det er høy intra-individuell variasjon mellom deltakerne, noe som er i tråd med tidligere studier utført av forskere som Larsen-Freeman (2006) og Rosmawati (2014). Til slutt er det tydelig når man undersøker samspillet mellom konstruksjonens kompleksitet og nøyaktighet at ingen av deltakerne følger forhåndsbestemte kurs og alle deltakerne opplevde et skifte mellom positive og negative assosiasjoner i utviklingsbanen for konstruksjonens kompleksitet og nøyaktighet.

Abstract

Adopting a Complex Dynamic Systems Theory (CDST) framework, this longitudinal quantitative study explores the emergent dynamicity and development of complexity and accuracy in writing of eight Norwegian L2 learners of English. The investigation is conducted by a close examination of both the individual development of the complexity and accuracy constructs for each participant and the interactions between the two constructs over a three-year period. Subsequently, this thesis focuses on two research questions: 1. How does Norwegian lower-secondary learners' written work develop in terms of complexity and accuracy over a three-year period? and 2 How does the measures of complexity and accuracy constructs interact with each other over a three-year observational period?

Ten text samples with a length of 200 words each (±10%), were extracted from ten sample texts gathered from each individual participant and analysed by employing descriptive measures such as frequency counts to measure sentence types and error types and ratio analysis's such as Word/Finite Verb ratio and Error-Free Clause/Clause ratio.

Further, we utilized a correlation analysis to investigate the interaction between the two constructs. The overall findings in this master's thesis are that the participants did portray non-linear behaviour and a high degree of variability which arguably demonstrate some of the main characteristics of a complex dynamic system. The study also shows that there is a high intra-individual variability between the participants, which are in line with previous studies conducted by researchers such as Larsen-Freeman (2006) and Rosmawati (2014). Lastly, it is apparent when examining the interaction between the construct's complexity and accuracy that none of the participants follow predetermined courses and all the participants experienced a shift between positive and negative associations in the developmental trajectory of the construct's complexity and accuracy.

Acknowledgment

As the saying goes, all journeys must come to an end, and a journey it has been indeed. This thesis laid its roots a couple of years ago, as we as third year learners wrote a research paper on complexity and accuracy. However, such a complex topic deserved more space, and a more thorough investigation. Thus, largely expanded and with more experience, we started working on the thesis almost 8 months ago. Early mornings and late nights at the library, countless trips to the printer and reading what feels like a mountain of articles and papers.

First of all, I (Kamilla) would like to thank my thesis partner Sander – for continued support during my many moments of doubt and stress. You have been a true rock during this process, and with your calm nature, have been able to calm me too. I could not have done this without you Sander. I would also like to appreciate your patience working with a single mother which undoubtedly has affected my working hours.

Secondly, I (Sander) would like to thank my thesis partner Kamilla – without you this thesis would not be possible and after many months of work we are finished and still friends. Thank you for all the support and all the kind words.

We would also like to thank our family and friends, for their love and support. Especially during the last month, with countless hours of babysitting, which gave us the opportunity to finish this thesis.

Lastly, we would like to thank our supervisor Saeed Karimi Aghdam Ordaklou for his immense knowledge and plentiful insight when collecting research for this project. Without your invaluable advice this master's thesis would not be possible.

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List of Abbreviations

Abbreviations	Definition
SLA	Second Language Acquisition
SLD	Second Language Development
ESL	English as a Second Language
L2	Second Language
L1	First Language
CT	Complexity Theory
DST	Dynamic Systems Theory
CDST	Complex Dynamic Systems Theory
CAF	Complexity, Accuracy and Fluency

1 Introduction

Writing is one of the four essential skills in language, and writing is arguably the most challenging skill to master. One could argue that in a multilingual world such as the world we live in, where more than three-quarters of all humans on the planet speak two or more languages and the fact that English arguably has become the lingua franca for many people that do not share the same mother tongue. Being a proficient English writer in modern society is not only viewed as a commodity but arguably a necessary skill to be able to participate in the increasingly globalized world (Crystal, 2006, p. 406). In the modern world, globalization has increased the mobility of technology, information, capital, and people. This has arguably led to a global revolution where many citizens participate in a grander global culture where the participants develop shared values with speakers from around the world rather than exclusively relying on values shared by local culture in their own country or even the values predominantly found within the geographical location speakers have access to. In many countries, such as Norway, the English language has arguably grown to the extent that it is no longer considered a foreign language but an unofficial second language. Rindal (2014) explains the status of English in Norway in her article entitled "What is English?":

> *Norway is no exception to the exceptions of the concentric-circle categories. Norway is traditionally an expanding-circle country with foreign-language status for English; taught at scheduled hours in the classroom, and acknowledged for its significance to education, business and mobility, but not an official second language. However, Norway has seen an increase in English language access and domain use. In large companies English is often used as lingua franca ..., and in higher education a considerable amount of written material and lectures are given in English (p. 8).*

It is clear that one could argue that English has become a lingua franca in many aspects of Norwegian society. Not only have large companies and institutes of higher education started to utilize English as means of communication and language of instruction, but young Norwegian has, in the past few decades, experienced massive exposure to English media in their daily life (Rindal, 2014). However, an aspect of English that highlights the importance of being a proficient user of the English language is that most English interactions in today's

society are conducted between non-native speakers (Rindal, 2014). Rindal (2014, p. 8) argues that English increasingly becomes characterized by those who use it as a second language, and that English increasingly belongs to the world as it is shaped and used by different communities and utilized for different purposes. In Norway, language education authorities have recognized the fact that English is a global language. In the Norwegian national curriculum, it is stated explicitly that "English is an important subject when it comes to cultural understanding, communication, all-round education, and identity development. The subject shall give the pupils the foundation for communicating with others, both locally and globally, regardless of cultural or linguistic background (Ministry of Education and Research, 2019, p. 2) (Ministry of Education and Research, 2019, p. 2)". Further, a core element in the national curriculum is "Language learning". Within the core element of "Language learning", education authorities have explicitly stated that learners need to develop "language awareness and knowledge of English as a system … and to understand how English is structured (Ministry of Education and Research, 2019, p. 2)". During our five years in university, we have had the opportunity to teach at several schools. A common challenge we faced was to effectively gauge the writing performance of lower secondary learners. One would imagine that writing is a skill that is fairly straightforward to assess properly because learners produce something tangible that educators can, in hindsight, effectively assess in detail. One could expect that the developmental trajectory of learners' writing would follow a fairly linear and straightforward trajectory. However, in our experience, learners' writing does not necessarily improve over time, and in our experience, learner's writing skills fluctuate. Does this mean that they regress, or is it a sign of something else? As explicitly stated in the national curriculum for the English subject, language awareness and knowledge of English as a system is crucial to develop the ability to utilize language learning strategies (Ministry of Education and Research, 2019, p. 2). However, how can we expect learners to develop language awareness when certain aspects of language development are still arguably ambiguous and in need of further research? According to Larsen-Freeman (2006), many researchers within the field of second language acquisition have traditionally operated within the notion that language development follows a developmental ladder. Which means that researchers have viewed the act of developing a second language as the learner's ability to conform to a uniform target language that is generally viewed as one-dimensional subsystems the learner must master to develop the target language further (Larsen-Freeman, 2006). However, several prominent scholars, such as Larsen-Freeman (2006), Caspi and Lowie (2010), and van Dijk et al. (2011) argue that language is a complex dynamic system, comprised of a set of interconnected components subject to constant self-organization, thus

rejecting the notion of "end state". This system is multidimensional in nature and is characterized as complex intertwined components, non-linear, and arguably chaotic (Rosmawati, 2014).

The objective of this MA thesis is to investigate the nature of development and interaction of the complexity and accuracy constructs in the written texts of Norwegian English language learners over a three-year period in order to gain a longitudinal perspective on the dynamic nature of English language writing development – an area which needs more research as there is no previous research conducted in this particular field in a Norwegian language learner context. Second language writing presents itself as arguably one of the most crucial skills second language learners need to develop. Before tackling the theory of Second Language Writing Development, a brief presentation of the field of Second Language Acquisition is in order, followed by a discussion of Second Language Writing Development.

1.1 Field of Second Language Acquisition

Second language Acquisition (SLA for short) is the scientific field of study that examines people's ability to learn language, after acquiring their first language or languages (Ellis, 2021). The field of SLA investigates a wide range of intricate factors and phenomena that help explain a perplexing range of L2 learning output, in an array of contexts (Ortega, 2011). SLA materialized in the 1960s, and its inception is associated with the seminal papers by Corder (1967) and Selinker (1972) where the prevalent method of contrastive analysis, which entailed comparing the linguistic inventories of the first language (L1 for short) and second language (hereafter L2) employed in the learning process in search of acquisition solutions, was challenged. In lieu, Corder (1967) and Selinker (1972) contended that the tangible language produced by L2 learners should be the primary research interest. This necessitated a reconsideration of the "errors" L2 learners produce, from being treated as objects to be prevented or corrected, to being considered valuable investigative targets. By drawing upon a variety of established disciplines, such as linguistics and sociolinguistics, SLA expanded its scope of inquiry substantially in the 1980s (Ellis, 2021). According to Ellis (2021), SLA brought on four key areas of inquiry namely language transfer, linguistic universals, second language pragmatics and input/interaction, which are still pertinent and current today.

The cognitive influence on SLA, from several strands of cognitive psychology, became more apparent in the 1990s (Ellis, 2021). Ellis (2021) highlights the antithetical theories on the role of consciousness in language learning has given rise to on one side those who contended

that consciousness was essential and on the other side those who argued that the learning process may be exclusively implicit. Approaching the turn of the century, Firth and Wagner (1997) called for a reconstruction of SLA by contending that an "enhanced awareness of the contextual and interactional dimensions of language use, an increased "emic" (i.e., participant-relevant) sensitivity towards fundamental concepts» (Firth & Wagner, 1997, p. 757). Marking the start of what has come to be known as the «social turn» in SLA (Ellis, 2021), Firth and Wagner (1997) contributed to arguments about how cognitive processes alone are incapable of explaining L2 acquisition. Furthermore, they acknowledged the complex and social nature of learners, and how research on L2 acquisition should investigate the continuous process of reciprocal interaction and between the social context and individual learners (Firth & Wagner, 1997).

Despite research developments, the field of SLA is still largely comprised of two axiomatic paradigms of SLA, namely cognitive SLA and Social SLA (Karimi-Aghdam et al., 2016; Larsen-Freeman, 2007), which account for the dichotomous and divided nature of the SLA field. Cognitive SLA has, since the dawning of the SLA field, been the preeminent orientation towards SLA, and is thus considered "traditional" (Ortega, 2011). The general assumption within the cognitive SLA paradigm has been that L2 acquisition is "a genetically deterministic attainment (…) a teleological unfolding and orderly differentiation of an inborn language faculty which is triggered by external language input" (Karimi-Aghdam et al., 2016, p. 166). In other words that language learning within cognitive SLA is viewed as a natural ability, determined by genetically endowed language learning faculty and unfolds in an organized fashion as a response to being exposed to new linguistic output. Contrariwise, socially oriented SLA approaches maintain L2 learning to be "a probabilistic contingency and see L2 development as an individualistic aggregate of fragmentary discrete and additive tokens of purpose-shorn and quantitative changes engendered solely by experiential and contextual factors"(Karimi-Aghdam et al., 2016). Thus, within social SLA, language development is viewed as a "quantitative addition of grammatical structures that are solely derived from language use in social interaction" (Karimi-Aghdam et al., 2016, p. 167), thus foregrounding the primary role played by the contextual and discrete variables of L2 development, since these fundamental and atomic elements are the only ones that contribute to constructing L2 knowledge and thus are for doing research on.

The turn of the century meant a continuation of the developments from the 80s and 90s, but also brought forward a new development, with the introduction of Complex Dynamic Systems Theory (CDST) (de Bot et al., 2007; Larsen-Freeman & Cameron, 2008). CDST

contends and demonstrates that language is a complex adaptive system, that demonstrates both stability and dynamicity (Hiver et al., 2022). The theory proposes that language *use*, through which the semiotic potential of language is realized, is "an iterative process of co-adaptation in which language users adapt to the context and other interlocutors" (Hiver et al., 2022, p. 915). CDST further postulates that the process of language development is non-linear, emergent and that it draws "on local-to-global processes of construction and global-to-local processes of constraint (Hiver et al., 2022). CDST thus acknowledges both a cognitive and social component in second language learning development and has thus contributed to the need for the development of a new SLA framework capable of "describing, explaining and understanding L2 development" (Karimi-Aghdam et al., 2016, p. 2) as a monolithic time-bound system, comprised of both cognitive and social dimensions, but that cannot be explained by reducing it to either of those two facts.

1.2   From Second Language Acquisition to Second Language Development.

The CDST perspective "rejects the commodification of language implied by the term "acquisition", instead imbuing language with a more dynamic quality, implied by the term "development" (Larsen-Freeman, 2015, p. 491), due to the fact that it views language as a resource that constantly develops. Larsen-Freeman (2015) points to the etymological meaning of acquisition (obtaining or gaining) and its implied meaning; an item that transitions from external to internal, which ultimately contributes to a sustained tendency to view language as an object. However, such objectification of language does not allow for the investigation of the "flexible, transient, dynamic aspects of learner language which emerge from its use" (Ellis & Larsen-Freeman, 2006; Larsen-Freeman, 2015) and is pertinent to the notion of CDST. In addition, this perspective respects the fact that from a target-language vantage point, regress in learner performance is as characteristic of development as progress (Larsen-Freeman, 2015, p. 495). Applying the term "second language development" also recognizes that there is no common endpoint at which all learners arrive. This is supported by de Bot et al. (2005), who argue that acknowledging language as a dynamic system is in direct conflict with the concept of "end state", meaning a state signifying an end of development. The constant re-organisation of language thus results in a never-ending process. The term "development" also helps position the learner as actively participating in meaning-making. Larsen-Freeman (2015) has argued that though it may seem like a simple substitution, to use "development" in place of "acquisition", there are important consequences that fundamentally affect our understanding

of the subject. Arguably, scholars who apply the term "development" as a substitute for "acquisition" in their research papers concur with the argument put forward by Larsen-Freeman (2015). Notable mentions include Verspoor et al. (2011) and Verspoor and Bot (2021). In the next section, we will discuss writing in English as an L2, focusing on how the learning process is different from learning to write in one's first language.

1.3 Second Language Writing Development and its Unique Characteristics

Writing is a complex and multifaceted activity that encompasses both the process of composing and the final product that results from that process (Cope & Kalantzis, 1993; Polio & Park, 2016; Weigle, 2014). Learning to write, therefore, involves developing the skills needed to create written text and an understanding of the forms and structures that govern different genres and styles of writing. Additionally, writing has a social dimension that must be considered, including factors such as audience, voice, and purpose, which can shape the way writers approach their work and the kinds of text they produce (Weigle, 2014).

1.3.1 Second Language Writing Development Research

Second language development and second language writing are highly complex and multifaceted phenomenon (Cumming, 2001; Manchón, 2012). The majority of L2 writing research has been heavily reliant on L1 research, although L2 writing differs from L1 writing in many aspects, including strategy, rhetoric, and linguistics (Silva, 1993), L1 models have had a considerable impact on L2 writing education and the creation of a theory of L2 writing. In the research on writing development, the foci have historically been on three essential dimensions of writing, each with a respective micro- and macro perspective. The three dimensions are 1) Written text features, 2) the composing process and its subprocesses and 3) the sociocultural contexts (Archibald & Jeffery, 2000; Cumming, 2001). These three dimensions are in themselves a testament to the complexity and intricacy of the writing process, which is further complicated by the innately recursive nature of writing (Archibald & Jeffery, 2000; Silva, 1993).

Learning how to write in a L2 is one of the most challenging aspects of L2 language learning (Hyland, 2003). The highly complex nature of writing itself is converged by several prominent scholars, such as Cope and Kalantzis (1993), Silva (1993), Weigle (2014), Polio and Park (2016) and Cumming (2001). Thus, the task of writing is challenging, regardless of

whether it is in an L1 or L2. However, in their L1 the learners will have already developed an understanding of writing, through storytelling, interacting with others and observing the writing process. They would have also acquired a rich vocabulary before starting to learn writing, whereas in their L2, the learner must adjust to a new writing system while simultaneously developing a new vocabulary (Olshtain, 2014). Thus, the prerequisites for the learning process itself are vastly different between L1 and L2.

Writing requires high cognitive processing, such as generating and organizing, monitoring and revising the text they produce and keeping in mind their overall message (Weigle, 2014). Regardless of the similarity in the cognitive demand that writing puts on the writer, there are a number of pertinent differences between L1 and L2, concerning both the composing process, its subsequent subprocesses and the characteristics of the written text (Silva, 1993) which will be elaborated on in the following section.

1.3.2 *Differentiating Between the L1 And L2 Writers and Their Writing Process.*

Surface-level evidence, indicated by Silva's (1993) examination of 72 empirical reports, suggests that the writing process in L1 and L2 have a similar overall structure. Writing in both languages entails a recursive writing process that involves planning, writing, and editing to develop one's ideas and choice-making regarding employing the best rhetorical and linguistic ways to communicate them (Hayes & Flower, 1986; Silva, 1993).

However, Silva (1993) has revealed salient and crucial differences in the writing process of L1 and L2 writing, differences that pertain to both the composing process and the subprocesses of planning, transcribing, and reviewing (Silva, 1993). It was found that the composition process of L2 writing clearly was more demanding and less effective, compared to L1 writing. The L2 writer engaged less in the pre-writing subprocess of planning, at both global and local levels. Despite more attention being directed towards generating and creating content, the L2 writer typically displayed greater difficulty and was less successful in that more time was spent researching the subject, less useful content was created, and more of the ideas that were created never made it into the written text (Silva, 1993). This body of research also found that the transcribing (i.e. the production of written text) of L2 writers, was "more laborious, less fluent and effective" (Silva, 1993, p. 661). The L2 writer struggled with recalling lexis, paused more frequently and for longer periods of time, resulting in more time consumed in the writing process (Silva, 1993, p. 662), and a premature focus on the sentence level (Weigle, 2014). Silva's (1993) research also found that L2 writers revised more – but more

laboriously and with less ability to do so instinctively, however, they reviewed less. One could therefore argue that the L2 writers were less able to reflect upon and assess their written work and instead spent time editing their text on a surface level.

Another pertinent distinction between L1 and L2 writing is the differences regarding the features of the written text. Silva (1993) identified differences regarding fluency, accuracy, quality and structure. Overall, the texts written by L2 writers were "less fluent, less accurate and less effective" meaning that the texts consisted of fewer words, were more prone to errors and were perceived as lower in quality (Silva, 1993). The texts produced by L2 writers also exhibited a unique style and a simpler structure, compared to texts produced by L1 writers.

The differences between L1 and L2 writing have also been attributed to various factors including: the writer´s proficiency in the target language (Cumming, 1989), familiarity with the target language genres and related sociocultural expectations (Cope & Kalantzis, 1993; Silva, 1997) and the intersection between the writer's L1 experiences and the meaning of literacy in the target language culture (Bell, 1995; Cope & Kalantzis, 1993).

1.3.3   L2 Proficiency and Transfer Between L1 And L2

As previously mentioned, much research in the area of L2 writing development has been deeply dependent on research on L1 writing development, arguably under the assumption that the writer is able to transfer his or her rhetorical knowledge about writing to their L2 (Weigle, 2014). The ability of the learner to transfer such skill from their L1 to their L2 positively correlates with their L2 proficiency level (Weigle, 2014). This means that while L1 writers arguably can rhetorically express their thoughts with ease, L2 writers face difficulties in reflecting their ideas in a language that is not their native one, resulting in difficulties in the transfer of rhetorical knowledge from L1 to L2 (Weigle, 2014).

1.3.4   Importance of L2 Writing Research and Investigating its Various Dimensions

In recent years, writing and its teaching in both first and second-language contexts have become focal points of research and educational efforts. Much of the motivation behind conducted L» writing has been rooted in improvement of teaching practices according to Ellis (2015), Larsen-Freeman and Long (1991) and Harklau (2002). However, as pointed out by Polio and Park (2016) among others, is that the research on L2 development and L2 writing

has few clear pedagogical implications. Despite no or few clear pedagogical implications at this exact moment, this following quote by David Cook (1965), is noteworthy:

> *«We sometimes overlook the fact that there is much that we can know and*
> *need to know about our universe and ourselves that is not necessarily useful*
> *at the moment of discovery. By the same token, we are too prone to reject*
> *knowledge for which we cannot find an immediate practical application.*
>
> *(p. 9)»*

Thus, the knowledge we generate while conducting L2 research, though it might not seem like it has direct pedagogical implications at this very moment – might be of incremental importance in future research endeavours. Further, as stated by Corder (1981, p. 7) «efficient language teaching must work with, rather than against, natural learning processes, facilitate and expedite rather than impede learning». To be able to do this, we as teachers and researchers need to *understand* these natural processes. The conundrum of Second Language Development (hereafter SLD) and the complexity of the fields, as captured by CDST, still has unanswered questions, and further research is thus needed.

1.4   Research Questions

Drawing inspiration from a research paper conducted by Rosmawati in 2014, the purpose of this MA thesis is to apply the empirical procedures carried out by Rosmawati in a Norwegian lower-secondary context. The following study will carefully examine the longitudinal development of the L2 writing of 8 Norwegian lower-secondary learners, focusing on accuracy and complexity, and aim to answer the following questions:

RQ1: How does Norwegian lower-secondary learners' written work develop in terms of complexity and accuracy over a three-year period?

RQ2: How does the measures of complexity and accuracy constructs interact with each other over a three-year observational period?

2   Theoretical Framework and Literature Review

In this chapter, we set out to review literature that examines how Complex Dynamic Systems Theory can be used to examine the developmental trajectory of L2 English language users in the Norwegian classroom context. Firstly, we will conduct a review of Complex Dynamic Systems Theory (hereafter CDST) in an English L2 context. Secondly, we will examine the individual constructs within the CAF triad thoroughly, and thirdly, discuss the interaction of the constructs to gain a deeper understanding of how these constructs will interact with each other. Lastly, we will examine studies that utilize the CAF triad as a means to explore the dynamicity of second language acquisition.

Writing calls on pupils to assess and make deliberate decisions in the meaning-making process, in contrast to other essential abilities like speaking, which depends more on spontaneity – making it a skill that is both demanding and taxing. Main proponents of CDST have maintained that SLA theories have been anchored on an assumption that acquiring a second language is a linear process. For example, Larsen-Freeman (1997) argues that due to the backslides, stagnations, and leaps in learning, it is not always evident which instances of instruction or input will result in which instances of learning; thus, L2 learning is not a simple linear progression based on the input (Larsen-Freeman, 1997, p. 151).

It seems that the English curriculum in Norway supposedly assumes that L2 learning is a linear process and develops in a step-wise fashion with what is thought in classroom context. It might be argued that this linearity "bias" is evident in the phrasing of the English subject curriculums in outlining how the basic skills of reading, writing, and oral and digital skills emerge in the English subject (Ministry of Education and Research, 2019). For example, the curriculum states that "the development of writing proficiency in English progresses from learning single words and phrases to creating different types of coherent texts that present viewpoints and knowledge" (Ministry of Education and Research, 2019, p. 4). The term "progresses" is paired with writing development, which is a term that evokes strong connotations of improvement and enhancement, and thus quite possibly expresses an expectation of a linear-like development. Thus, it might be argued that the national subject curriculum does not acknowledge the inter-individuality of the developmental process, which includes periods of restructuring of the systems visible as a perceived decline in proficiency, which ultimately is indicative of development and growth.

In applied linguistics, Diane Larsen-Freeman pioneered the application of Complexity Theory (CT) with her paper published in 1997 entitled "Chaos/Complexity Science and Second

Language Acquisition″. Since then, several scholars, have adopted a CDST perspective on L2 development, which provides a framework for understanding the plethora of factors that actively affect each other in the learning process, thus affecting the developmental trajectory.

Investigating the developmental trajectory of pupils' writing ability is of paramount importance, as it can help shed light on the process itself, and also other pedagogical and educational purposes. Nonetheless, the task of describing the development of second language writing skills is a challenging issue as it entails a plethora of factors that actively affect each other. Complex Dynamic Systems Theory is a fairly recent addition to applied linguistics but presents itself as a compelling framework. First, in this literature review the historical foundation of second language acquisition (SLA) is briefly discussed before discussing writing in English as a second language and how it is different from writing in one's first language. It provides a sequence into delving deep into the progenitors of CDST, and how it is applied within Applied linguistics. This is then followed by a thorough review of the CAF-triad, its interconnectedness, and its use as a measurement tool for gauging learners' L2 development.

2.1   Antecedents of Complex Dynamic Systems Theory

Through the last 30 years, several social and human disciplines, such as psychology (Thelen & Smith, 1994; van Geert, 1991) and applied linguistics (de Bot et al., 2007; Larsen-Freeman, 1997; Larsen-Freeman & Cameron, 2008) have increasingly embraced the Complex Dynamic Systems Theory (CDST) approach to comprehending change over time, in a wide variety of phenomena. CDST is the proposed term for both Complexity Theory (CT) and Dynamic Systems Theory (DST), which in the context of Applied Linguistics (AL) has been used interchangeably in the literature despite a difference in ontology (de Bot, 2017). Although it would be more conceptually straightforward to have a single term, the decision of which one to use between CT and DST poses a challenge. In applied linguistics, CT is more closely associated with the research done by Diane Larsen-Freeman and her team, while DST is linked to the work conducted in Groningen, with scholars such as Paul van Geert and Han van der Maas. There is no evidence to suggest having two distinct labels for the same phenomenon poses an issue; however, this thesis will draw on the material from both Larsen-Freeman's CT tradition and the DST perspective attributed to Groningen, and thus the term CDST, coined by de Bot (2017) is more appropriate. Both CT and DST have numerous disciplinary progenitors, thus this thesis will selectively trace their genealogy (de Bot, 2017; Port & van Gelder, 1995; van Geert, 2003) by pointing to key influences on the development of each theory.

2.1.1 *Complexity Theory in SLA*

A key influence on the development of CT, can be traced back to the 1940s and the work of biologist Conrad Waddington. His research on embryogenesis went against the prevailing belief at the time, by opposing the notion of genes carrying the full description of an organism's form by discovering that the form of the body is not predetermined by a comprehensive set of instructions but is "constructed by the construction process itself" (van Geert, 2003, pp. 648-649). Von Bertalanffy (1950) proceeded and proposed "general systems theory" to account for how complex order evolves. He argued against the reductionist view that an entity can be explained as the sum of its constituent parts. Instead, he advocated a systems approach that focuses on understanding how the interactions between the parts connect and engender the whole. Other important influences include Varela and Maturana's (1972) research on autopoiesis, and Prigogine and Stengers (1984) research on self-organization.

Larsen-Freeman (1997) attempted in her seminal article to connect this tradition of CT from the natural sciences to AL, and thus laid the foundation for a complexity epistemology in AL. Larsen-Freeman (1997) put forward broad brush claims, summarized in 10 primary tenets of what constitutes a CT, which were both metaphorical and explanatory in nature; statements which resulted in 7 primary tenets of CT-for-SLA (see table 1 below).

Table 1: Primary axioms of CT-for-SLA

1	Patterns in language arise from individuals interacting, adapting their language resources to changing environment.
2	Every meaningful use of language changes the resources of the language learner/user, and the changed resources are then potentially available for the next speech event.
3	Affordances need to be established for learning from a second language learner's emic viewpoint, bearing in mind that learners may well have experience with multiple languages, and they may be learning in an environment that is not monolingual.
4	Language use cannot be carefully segregated from tis ecology.
5	Language is a complex adaptive system. A model of change that can account for nonlinearity in SLA, such as U-shaped learning curves, is necessary.
6	Language is a self-modifying, emerging system.
7	Second language development requires systems perspective; it need to be looked at holistically, rather than in a piecemeal, atomized way.

Source: (Han et al., 2022)

The new paradigm proposed by Larsen-Freeman (1997) in her seminal article essentially advocates a focus on exposing or discovering relationality, interactivity, and reciprocity in learner language and its development, requiring knowledge of the ecosystem in which interactions between the social environment and the organism take place. Dynamic systems theory, which will be covered in more detail in the next part, has over time become an ally and echo for this perspective.

2.1.2 Dynamic Systems Theory in SLA

In AL Dynamic Systems Theory (hereafter DST) is a manifestation of a branch of thinking within cognitive psychology about growth and learning (Thelen & Smith, 1994; van Geert, 1995; van Gelder, 1998) which drew inspiration from the mathematical framework leveraging differential equations to model complex dynamical systems, namely Dynamical Systems theory. The theory of Dynamical Systems, also referred to as Chaos Theory or Nonlinear Dynamics, is a mathematical theory, concerned *exclusively* with mathematics. Thus it is important to notice, that *dynamic* (as opposed to *dynamical*) systems theory is less purely mathematically oriented, and represents a metaphorical approach, which uses the mathematical vocabulary and concepts provided by *Dynamical* Systems Theory, in order to describe the

"changing, hard-to-predict macroscopic behaviour" which is the "hallmark of complex systems, […] in terms of bifurcations, attractors and universal properties of the ways systems change (Mitchell, 2009, p. 38).

2.1.3   Conceptualising DST: What Characterises a Dynamic System?

DST poses temporal *change* as the pivotal point of both its theory and method. This provides a contrast to other theories of SLA and L2 development, where a preference for the artifice of synchronicity is evident (Larsen-Freeman & Cameron, 2008). The developmental process in and of itself is the main emphasis of DST, in lieu of the outcome or the end result of the said process (Caspi & Lowie, 2010). A system consists of distinct, interconnected components and their interactions (Van Geert, 2008). Furthermore, the concept of dynamic systems is encapsulated by continuous change (Rosmawati, 2014). Caspi and Lowie (2010) define a dynamic system as:

"… a set of changing components that influence each other. These components can be described as dynamic sub-systems nested in the greater system, and which in turn comprise of interacting, developing subcomponents. Not only do the components of a complex system change over time, but their interaction itself is also dynamic and changes with time.

(Caspi & Lowie, 2010, p. 42)

Caspi and Lowie's (2010) definition emphasizes four essential conceptions that are characteristic of a dynamic system, namely "highly intertwined components, nestedness, change over time and nonlinearity" (Rosmawati, 2014, p. 68). Which according to de Bot (2008) is visible in language development as "sensitive dependence on initial conditions, the complete interconnectedness of subsystems, the emergence of attractor states in development over time and variation both in and among individuals" (de Bot, 2008, p. 7). According to de Bot (2008) is visible in language development as "sensitive dependence on initial conditions, the complete interconnectedness of subsystems, the emergence of attractor states in development over time and variation both in and among individuals" (de Bot, 2008, p. 7) According to de Bot (2008) is visible in language development as "sensitive dependence on initial conditions, the complete interconnectedness of subsystems, the emergence of attractor states in development over time and variation both in and among individuals" (de Bot, 2008, p. 7). The interconnectedness and interrelatedness of the components (and subsystems), means that "changes in one variable will have an impact on all other variables that are part of the

system" (de Bot et al., 2007, p. 8). The intertwined components that constitute a dynamic system form subsystems based on the proximity of the relation between them. The subsystems are subsequently and equally comprised of interconnected components, that again form subsystems further composed of subordinate components (de Bot et al., 2007; Rosmawati, 2014). Therefore, as the nestedness of a dynamic system denotes, "every system is always a part of another system (…) with the same dynamic principles operating at all levels" (de Bot et al., 2007).

The dynamicity of the system is evident in that both the components and how the interactions change over time. They adjust themselves and their interactions continually and concurrently in response to the input from each previous interaction (Rosmawati, 2014). This susceptibility to feedback adds to the variability in the way dynamic systems evolve over time. Thus, dynamic systems develop through an iterative process where the system's current state, or iteration, serves as input for the following proximal state (Thelen, 2005). In addition, the system internally self-organizes, thus fashioning itself without any external force or input as such. Henceforth, through a repetitive, iterative process of testing, feedback collection and self-organising internalization (Caspi & Lowie, 2010; de Bot & Larsen-Freeman, 2011) the system generates structures displaying the characteristics of fractal shapes (Evans, 2020); shapes that when enlarged "reveal increasingly smaller, yet self-similar patterns across all scales of measurement" (Evans, 2020, p. 701). This ultimately results in the emergence of complexity (Ellis, 2008; Larsen-Freeman, 2012; Van Geert, 2008) with displays of variability and unforeseeable behaviour (de Bot, 2008; de Bot et al., 2005).

The developmental trajectory of a dynamic system exhibits nonlinearity, as there "is a non-linear relationship between the size of an initial perturbation of a system and the effects it may have in the long run" (de Bot et al., 2007, p. 8). It follows that the effect might be disproportionate to its cause ((de Bot & Larsen-Freeman, 2011; Rosmawati, 2022). Consequently, the developmental process of a dynamic system does not appear to follow a step-by-step, linear trajectory. Instead, it ebbs and flows, creating significant fluctuation (van Dijk et al., 2011; van Geert, 2002; Verspoor et al., 2008). The dynamic system's sensitive dependency on initial conditions suggests that minute variations in the initial state might result in significant changes later on (de Bot et al., 2007; Han et al., 2022). Lorenz's (1963) B*utterfly Effect* is a frequently recognized metaphor to describe this phenomenon of dependency on initial conditions and nonlinear development In sum, the outward behaviour of a dynamic system is neither the outcome of a single component or subsystem nor a straightforward

cumulative outcome of all the aggregates (Rosmawati, 2022), rather "it emerges from the interactions of its components" (Larsen-Freeman, 1997, p. 143).

2.2 Complex Dynamic Systems Theory: Integrating CT and DST

Outlining the foundational axioms of DST reveals several parallels and intersections with CT. Han et al. (2022) assert that the "merging of CT and DST for SLA is natural and inevitable" (Han et al., 2022, p. 10). As a continuation of the argument put forward earlier, CDST has been proposed by de Bot (2017) and Larsen-Freeman (2020) as the agreed upon term. Thus, CDST is a meta-theory (Karimi-Aghdam, 2016b) that in addition to offering an ontological stance on the nature of reality, the theory also captures the epistemological notions that facilitate scientific thinking and inquiry (Hiver et al., 2022). Thus, CDST offers a framework for understanding language in complex and dynamic terms and acknowledges that it cannot be fully comprehended through simple cause-and-effect relationships (Karimi-Aghdam, 2016a) or by viewing language as a fixed entity. Additionally, epistemological ideas aid in language theory development and encourage a rigorous, evidence-based approach to language studies.

2.3 Outlining the basic tenets of CDST

The primary focus of CDST is the study of complex systems (Al-Hoorie et al., 2023). Complex systems are "systems that are heterogenous, dynamic, non-linear, adaptive and open" (Larsen-Freeman & Cameron, 2008, p. 38). Thus, there are a multitude of different kinds of elements that comprise a complex system (term used to refer to the system which CDST as a theory is concerned with) , and the elements could themselves be complex systems, and subsequently subsystems within the larger system (Larsen-Freeman & Cameron, 2008). The dynamic aspect of a complex system entails that the system is subject to continuous change, both in the sense that the elements comprising the system change, but also the interaction between these elements change (Larsen-Freeman & Cameron, 2008). A result of this dynamicity is the non-linear outcome; "change that is not proportional to input" (Larsen-Freeman & Cameron, 2008). The notion of openness accounts for how a complex system is 'open' to the environment, and thus characterized by a continuous movement of materials and energy into and out of the system. Reaching equilibrium is, therefore, impossible for a complex system, however, the system could reach what is known as dynamic equilibrium (?). This state of dynamic equilibrium is further maintained by how the complex system adapts to changes in

external factors through an adaptation process (Larsen-Freeman & Cameron, 2008). The interconnectedness and openness of a complex system imply also that the social, physical and cognitive are interconnected; and also how context is inextricably connected to the system (Larsen-Freeman & Cameron, 2008). Thus, in addition to the characteristics of non-linearity, sensitive dependence on the initial condition, complete interconnectedness and iteration, as described above and in the conceptualization of DST, de Bot and Larsen-Freeman (2011) outline several other basic characteristics of CDST, which will be explored briefly below.

2.3.1 Change through internal reorganization and interaction with the environment

The first additional basic characteristic (de Bot & Larsen-Freeman, 2011) is "Change through internal reorganization and interaction with the environment". CDST postulates that "There is no goal or direction in development; there is only change" (de Bot & Larsen-Freeman, 2011, p. 13). The system reacts to external input and its entire organization […] changes with new input". The two forces of environmental interaction and internal re-organization are in a perpetual dance, constantly at work to maintain equilibrium. The interaction with the environment is a testament to the openness of complex systems.

2.3.2 Dependence on internal and external resources

Secondly, the growth process (i.e. the development of a complex dynamic system) is "dependent on internal and external resources" (de Bot & Larsen-Freeman, 2011). This is characteristic of complex dynamic systems (CDS), as both language learning and use are equally resource-dependent (de Bot & Larsen-Freeman, 2011). Van Geert (2008) differentiates between resources internal resources (i.e. cognitive factors) and external resources (i.e. social factors and context) (de Bot & Larsen-Freeman, 2011; Yu & Lowie, 2019). The fact that these resources are limited, interconnected and compensatory, in terms of L2, might prompt the learner to prioritize one dimension such as accuracy over other dimensions such as complexity (de Bot & Larsen-Freeman, 2011; Skehan, 1998).

2.3.3 Constant change and attractor states

As can be seen from the earlier discussion, systems are continuously interacting with their environment and reorganizing themselves due to internal changes, thus displaying non-linear behavior. van Geert (2002) posits that dynamic systems evolve in the direction of some

type of equilibrium, though it might be both dynamic and temporal. "The state to which they are attracted, that is, towards which they spontaneously evolve as a consequence of the underlying dynamics principles that govern their behavior, is called the system's attractor" (van Geert, 2002). Attractor states are defined by and result from the systems development(de Bot & Larsen-Freeman, 2011). In terms of SLD, de Bot and Larsen-Freeman (2011) state that fossilization (i.e., stagnation in the development of an L2) might benefit from being called an attractor state.

2.3.4   Emergent properties

Lastly, emergent properties are qualities of a system, that initially were not recognized as functional elements of the system. The interaction between low-level elements gives birth to high-level features, for example how a car is composed of many interconnected components, yet it depends on all of them to operate, and thus the car is more than the sum of its components (de Bot & Larsen-Freeman, 2011).

2.3.5   Basic tenets: Comments on the Empirical Evidence

Han et al. (2022) refrain from coining these features as basic characteristics and rather name them mere assumptions. They point to the fact studies on CDST have fallen "substantially short on evidence on most of the […] characteristics (Han et al., 2022); namely, complete interconnectedness, change through internal reorganization and interaction with the environment, dependence on internal and external resources, constant change, with chaotic variation sometimes in which the systems only temporarily settle into "attractor states", change caused by interaction with the environment and internal organization and emergent properties. These characteristics, however, are widely accepted within the field as "givens", and despite not having an empirical establishment, they have in the context of SLD been implicitly accepted (Han et al., 2022). Thus, empirical evidence, according to Han et al. (2022) is only established for a) sensitive independence, b) nonlinearity in development and c) iteration.

2.4 The CAF triad: a developmental tool for gauging learner´s L2 development

2.4.1 *Historical overview and development of the CAF constructs*

According to several researchers, such as Larsen-Freeman (1978) and Skehan (1998) Skehan (1998), there is a need for a model that is able to gauge learners' proficiency effectively. This is due to the multidimensional nature of the L2 acquisition process, which in reality, makes it impossible to reduce second language acquisition into a singular aspect of investigation. Dynamic systems theory is undoubtedly a complex theory that requires models of analysis that are widely recognized within the discourse of CDST research. In the late 70s, Larsen-Freeman (1978) proposed the early iteration of a phenomenon known as the index of development. According to Larsen-Freeman (1978, p. 439) the index of development is an attempt to create "a developmental yardstick by which researchers could expediently and reliably gauge a learner's proficiency in a second language". Larsen-Freeman (1978, p. 440) elaborates further in her article "An ESL Index of Development" on the need for a common developmental yardstick that allows researchers to "give numerical value to different points along a second language developmental continuum". The vision of creating a common developmental yardstick to measure L2 proficiency became a reality when Skehan (1998) in the nineties introduced a proficiency model that was made up of the construct's complexity, accuracy, and fluency. The model Skehan introduced is called the CAF triad and has since the mid-1990s been established as a model that is able to describe the multidimensionality of language performance (Housen et al., 2012).

The constructs introduced by Skehan (1998) highlight different dimensions within L2 proficiency that gauge learner's developmental trajectories in an effective manner. According to Housen et al. (20112, p. 2), the need for a common developmental yardstick was introduced during a time when a distinction was made regarding the difference between fluent L2 speech and accurate L2 usage. One could not simply measure language proficiency by assessing singular aspects of language use or synthesizing the complex processes that arise in language use into a general model of language analysis. Norris and Ortega (2009, p. 557) further argue that "the overarching purpose in using CAF measures is to shed empirical light on how L2 develops by documenting what parts of the interlanguage system change as acquisition unfolds..". Initially, the CAF triad was used as dependent variables to investigate the effects of other factors (Housen et al., 2012, p. 2). However, recently there has been a turn in CAF research, where the CAF constructs themselves have begun to become the focus of

investigation. This newfound approach to the CAF constructs is suggested because CAF illustrates the psycholinguistic processes which underly the processing of L2 systems (Housen et al., 2012, p. 2). According to Housen et al. (2012, p. 3), the psycholinguistic approach has identified the constructs within the triad; complexity, accuracy, and fluency as competing and distinct areas of L2 performance. Due to this fact, all three constructs must be considered to gain a general insight into the learner's L2 production because together, the constructs within the CAF triad suggest the major stages of change in the development of L2 systems (Housen et al., 2012, p. 3). This includes, for example, the internalization of new L2 elements, which is highlighted by the complexity construct, the learner's ability to modify their L2 output which is highlighted by the accuracy construct, and the learner's proceduralization and consolidation of L2 knowledge, which is highlighted by the fluency construct (Housen et al., 2012).

The constructs that make up the CAF triad are highly multidimensional variables that are differentiated and manifested differently under different conditions of language use and develop differently from learner to (Housen et al., 2012). Due to this fact, there is a wide range of challenges that will arise when working with the CAF triad as research variables. This is because each construct within the CAF triad is made up of complex subsystems with multiple components, leading to the development of an effective CAF constitutes a major endeavour (Norris & Ortega, 2009). The challenges of developing an effective CAF constitute is mainly due to the dynamic nature of the constructs, as the constructs are at times unpredictable and in constant change (Norris & Ortega, 2009).

2.4.2   *Defining the components within the CAF triad*

In the 2009 article "Complexity, Accuracy, and Fluency in Second Language Acquisition", Housen and Kuiken (2009) identify several controversial issues that when conducting research within the field of CAF. Firstly, Housen and Kuiken (2009, p. 465) question the validity of the definitions used in CAF research through the question, "exactly what is meant by complexity, accuracy, and fluency, that is how can they be defined as constructs?". According to Housen et al. (2012) many studies adopting a CAF perspective fail to explicitly define the constructs within the CAF triad, which leads to many studies using the terms differently from study to study. There is arguably a lack of a common definition in the field, which can make it hard to interpret and compare findings in CAF research (Housen et al., 2012). However, since the nineties, there has been a general description of each construct in the CAF triad, which is still used today (Skehan, 1996). This master's thesis must therefore derive a consistent and clear definition of how each construct is used in an operationalized manner. By doing this, we will attempt to challenge one of the main hurdles of using the multifaceted CAF triad as a means of investing L2 writing developmental trajectory over time. We will base our study on the following general descriptors previously used by Rosmawati (2014). Accuracy is arguably the most straightforward construct in the CAF triad and can be generally described and defined as "The degree of conformity to certain norms" (Pallotti, 2009, p. 592) and reflects the "conformity of second language knowledge to the target language norms" (Wolfe-Quintero et al., 1998, p. 4). Further, the complexity construct is generally described and defined as "the extent to which the language produced in performing a task is elaborate and varied" (Ellis, 2003, p. 340). Lastly, the fluency construct is generally described and defined as "how comfortable the second language learner is with producing the target language" (Wolfe-Quintero et al., 1998, p. 9). The operationalized definitions of the constructs within the CAF triad are undoubtedly crucial for the methodological considerations in this master's thesis. Therefore, a more thorough operationalized definition of the constructs will be provided in the methodology chapter.

In light of the importance of a functioning operationalized definition of the constructs within the CAF triad, the second issue that Housen and Kuiken (2009, p. 466) have identified becomes crucial for a deeper understanding of how the construct is used to measure the developmental trajectory of L2 users. Housen and Kuiken (2009) posed the question of how the constructs within the CAF triad can best be operationalized as components of L2 performance in a straightforward and objective way when conducting empirical research using

the CAF triad (Housen & Kuiken, 2009). We have already touched upon the issue of creating a common operationalized definition when using the constructs within the CAF triad as research variables. However, an equally important issue is how the constructs are inconsistently assessed in empirical studies (Housen et al., 2012). The most common way of assessing data using the constructs within the CAF triad is by using objective quantitative measures such as indices, ratios, and frequency counts (Housen et al., 2012). Studies such as Rosmawati (2014) and Polat and Kim (2013) use quantitative measures such as frequency counts to investigate the subject's developmental trajectory within the construct's complexity and accuracy. For example, Rosmawati (2014) measured the complexity of an L2 writer at a postgraduate level by analysing complexity development by assessing her syntactical diversity and overall grammatical complexity in her written work over an academic semester. Syntactical diversity was measured by using a frequency count on sentence types, whereas overall grammatical complexity was measured by using indices such as word per finite verb (Rosmawati, 2014). Polat and Kim (2013), on the other hand, measured oral development over time, and they also chose to use frequency measures such as mean length of clauses, mean length of analysis of speech unit (henceforth called AS-unit), and clauses per AS-unit (Polat & Kim, 2013). However, a more subjective and holistic approach can also be used to measure the constructs within the CAF triad (Housen et al., 2012). A more holistic approach has led to the measurements of constructs such as complexity and accuracy being more general to gain a more comprehensive picture of the learner's developmental trajectory but in recent years researchers such as Norris and Ortega (2009) have argued for a further focus on measures that target specific subdomains of language as a complement to more global measures. Due to the analytical issues that arise when the data within the field can be hard to compare it is clear that it can be a daunting task to tackle the ever-increasing research repertoire that has emerged within the field of CAF. It can also affect the validity of the study due to the fact that many studies fail to view the CAF measures as dynamic systems that are interrelated (Housen et al., 2012). According to Norris and Ortega (2009), many of these issues can be challenged by basing our measurement practices on more organic measurements that are grounded in theory, which again highlights the multidimensionality of the constructs within the CAF triad.

In this master's thesis, we utilize the measurement tools used in Rosmawati´s 2014 study "Dynamic development of complexity and accuracy: A case study in second language academic writing". We chose to utilize these measurement points because, as previously mentioned, the measurements used by Rosmawati (2014) provide us insight into a plethora of areas within the participant's L2 performance. Where we will investigate the complexity

construct by examining syntactical diversity and overall grammatical and scrutinize the accuracy construct by examining error types and overall accuracy ratio in this study (Rosmawati, 2014) (Table 3). Further, we will in light of the measurement tools utilize a correlation analysis to explore the interconnectedness of the constructs within the CAF triad, as a correlation analysis in combination with measurement points that target, to a greater extent, specific subdomains of language will provide us with a more comprehensive picture of the developmental trajectory of each participant of this study (Rosmawati, 2014; Norris & Ortega, 2009).

2.4.3 *The Interconnectedness of the Constructs within the CAF Triad, Outside Factors and their Effect on the CAF Constructs*

There is a plethora of factors that might influence how each construct within the CAF triad will behave in an empirical setting. Firstly, the constructs within the CAF triad have until now been presented as somewhat independent subcomponents of a larger system. However, according to Larsen-Freeman (2009), it is about time that researchers within the field of CAF agree on the fact that the reductionist approach of examining each construct individually to gain a broader understanding of the developmental trajectory does little to advance our understanding of the L2 developmental process. Larsen-Freeman (2009) argues that there are outliers and limitations in viewing the data from a reductionist approach, even if the data might be considered reliable. By examining the constructs within the CAF triad individually, we will miss how these constructs interact with each other and how these interactions will change over time (Larsen-Freeman, 2009). According to Housen et al. (2012), there is strong evidence that the construct within the CAF triad does not develop collinearly in the second language acquisition process. The constructs interact in a manner where the constructs sometimes compete with each other. An early example of this phenomenon is catalogued by Ellis (1994), who speculated that increased development within the fluency construct could occur at the cost of the developmental trajectory of the construct's complexity and accuracy. Ellis (1994) argues further that the phenomena of competing constructs within the CAF triad are mainly due to the difference between knowledge analysis and knowledge automatization in the field of L2 acquisition. When learners write with a focus on increased fluency, they rely more on their automated language repertoire, whereas writing with a focus on accuracy relies to a greater extent on processes that focuses on acquiring new knowledge (Housen et al., 2012). Many researchers, such as Housen et al. (2012) and Bygate (2001), argue that human processing

capacity is somewhat limited. Due to this limitation in human processing capacity, the learners consciously and even subconsciously focus on different aspects within the CAF triad. The shifting focus learners exhibit in the writing process will lead to a competition between the constructs within the CAF triad, where for example the construct fluency is a form of L2 production that directly competes with attentional resources within the accuracy construct. Further, the accuracy constructs compete directly against attentional resources within the complexity construct (Housen et al., 2012). In this master's thesis, we will analyze the participant's individual developmental trajectory in light of each construct within the CAF triad. However, due to the interconnectedness of the constructs and the fact that the construct competes for attentional resources, we will also explore how the constructs interact with each other over time. The same purpose which Rosmawati (2014) arguably had in her study.

2.4.4   *Empirical CAF Studies Adopting a CDST Perspective*

In this section of the master's thesis, we will attempt to review empirical research that aims to investigate the developmental trajectory of L2 skills, such as writing and oral skills. We would further like to mention that in the Norwegian field of English didactics, there are yet-to-be-published empirical CAF studies that examine the developmental trajectory of Norwegian L2 learners in light of the CDST approach. This master's thesis will therefore be a novel study that attempts to utilize the emerging approach used by researchers such as Larsen-Freeman (2006) and Rosmawati (2014) to examine the developmental trajectory of English writing development of eight Norwegian L2 learners. A plethora of issues might arise when conducting this study, which will be partly addressed through our scientific theoretical consideration. In light of these considerations, we will examine the results of empirical studies utilizing the constructs within the CAF triad from a CDST perspective. Previously, we have discussed what the CAF triad is and why the CAF triad is used to measure the dynamicity of language development. We have also highlighted the issues that might arise when using the constructs within the CAF triad as a measurement tool. CAF is a fairly new approach, and CAF studies adopting a CDST perspective is an even newer field within the discourse of language development. Researchers such as Larsen-Freeman (2006), Polat and Kim (2013), Rosmawati (2014), and Spoelman and Verspoor (2010) have all increasingly started to use the CDST paradigm in research using the constructs within the CAF triad as a tool to measure empirical data in the development of L2 proficiency.

Larsen- Freeman (2006) is arguably the greatest pioneer within the field and is one of the first linguists to utilize the constructs within the CAF triad as a measurement tool to investigate the dynamicity of language development. In her 2006 mixed-method study, "The Emergence of Complexity, Fluency, and Accuracy in the Oral and Written Production of Five Chinese Learners of English" Larsen-Freeman (2006) observed the development of the three constructs: complexity, accuracy, and fluency in oral and written production of five high intermediate Chinese L2 learners. The data were collected four times over a six-month period. The subjects were told to write a narrative task of an episode in their life they wanted to share without worrying about the text being in perfect English and without using a dictionary. To measure their oral proficiency, they were asked to retell their narrative task orally three days after writing the story (Larsen-Freeman, 2006, p. 596). Larsen-Freeman (2006) highlights the fact that this study is an exploratory study, which means she provided a list of expectations, such as the presence of a somewhat stable variation of learner's production and a smoother ascending line at the group level compared to the individual level of each participant of the study (Larsen-Freeman, 2006, p. 596). According to Larsen-Freeman (2006), all the expectations set prior to the study were met, and one of the main findings of this study is that the average group data, which includes all five participants, shows that there is a continuous improvement in the development of each construct within the CAF triad. However, when examining the intraindividual variability, which has traditionally been viewed as a form of measurement error, it is clear that the participants in the study exhibited unique individual trajectories of development that support the notion within CDST theory that language development from the intraindividual perspective is somewhat nonlinear (Larsen-Freeman, 2006).

Traditionally, researchers within the field of second language acquisition operate with the metaphor that language development follows a developmental ladder (Larsen-Freeman, 2006). According to Larsen-Freeman (2006), the developmental ladder approach to second language acquisition generally follows the assumption that native languages are generally fixed and homogenous, which the learners have to master to be considered a fluent speaker. In light of this assumption, the language acquisition process is generally seen as a process where learners conform to a uniform target language through discrete stages that are generally seen as one-dimensional subsystems that must be mastered (Larsen-Freeman, 2006). In this developmental ladder approach learners generally move through the developmental continuum in a consistent manner where it is possible to have a two-phase research agenda, where researchers focus on understanding the learning process and later account for individual

differences (Larsen-Freeman, 2006). Larsen-Freeman's (2006) study undoubtedly highlighted those individual learners experience a unique developmental trajectory where learners show signs of non-linearity. The study goes against the previous notion that language development follows the developmental ladder. Due to Larsen-Freeman's (2006) results, there has been a spike in observation research that has begun to examine individual learners by utilizing the constructs within the CAF triad. Examples of such studies are Verspoor et al. (2008), Spoelman and Verspoor (2010), and Rosmawati (2014). Rosmawati (2014), where all studies which arguably support the general claim proposed by Larsen-Freeman (2006) that the learners within the studies experience individual trajectories where complex subsystems within language development compete with each other, and there is a clear non-linearity when examining their developmental continuum (Larsen-Freeman, 2006). According to Fogal (2022, p. 197), one of the main findings in Larsen-Freeman´s (2006) article is that variability precedes developmental jumps. The study "Variability in second language development from a dynamic systems perspective" conducted by Verspoor et al. (2008) advanced the notion that variability precedes developmental jumps by arguing that the differences in variations on a continuum may be stages of development (Fogal, 2022) (Verspoor & Sauter, 2000)The notion that these variations that arguably do appear somewhat nonlinear and chaotic may refer to stages of development further support a claim made by de Bot and Larsen-Freeman (2011) that argue that even if there are signs that the developmental continuum is somewhat nonlinear and chaotic, and there is still overall language development over an extended period of time.

According to Spoelman and Verspoor (2010) their 2010 study entitled "Dynamic Patterns in Development of Accuracy and Complexity: A Longitudinal Case Study in the Acquisition of Finnish" was an attempt to use CAF measurements in a way that is able to capture the multivariate and dynamic nature of the constructs within the CAF measures. Spoelman and Verspoor (2010, p. 532) purported to investigate the assumption that CAF measures are not collinear and do not remain constant over time. To investigate this assumption, they needed to analyse longitudinal data to best understand the multivariate and dynamic nature of the CAF measures. Spoelman and Verspoor (2010) wanted to utilize CAF measures with more dynamic descriptors, as Larsen Freeman did in her 2006 study. An example of a dynamic descriptor Spoelman and Verspoor (2010) utilized is the acquisition of morphology, as the Finnish language is known for its complex and rich morphology. The study uses longitudinal data from a single participant, a native Dutch speaker who acquired Finnish as a foreign language (Spoelman & Verspoor, 2010). Spoelman and Verspoor (2010) discovered within the accuracy construct that the participant generally had high accuracy rates.

Spoelman and Verspoor (2010) did find that the earlier measurements within the construct showed relatively high variability in the earlier texts. However, this is as expected and also a testament to the importance of a longitudinal approach to capture the multivariate and dynamic nature of the CAF measures (Spoelman & Verspoor, 2010). Within the complexity measures the participant had an overall increase and several of the measures seemed to support each other, meaning one could argue that they are somewhat interconnected (Spoelman & Verspoor, 2010). However, Spoelman and Verspoor (2010) conclude that the construct's complexity and accuracy are not constant over time and are not collinear, which aligns with earlier findings from the field (Larsen-Freeman, 2006; Larsen-Freeman & Cameron, 2008; Verspoor et al., 2008).

The study "Dynamics of Complexity and Accuracy: A Longitudinal Case Study of Advanced Untutored Development" by Polat and Kim (2013) is the first attempt to measure the developmental trajectory of an untutored learner over a longer period of time. Polat and Kim (2013) set out to measure oral proficiency and investigate the construct's complexity and accuracy by tracing syntactic complexity, accuracy, and lexical diversity over a period of one year. An interesting aspect of this study is that Polat and Kim (2013) chose to include interviews with three native speakers conducted under similar circumstances to be used as comparisons to the untutored learner. Further, the researchers extracted 100-word passages from each interview, which later were divided into AS-units (Polat & Kim, 2013). To measure complexity, the researchers measured syntactic complexity using the measurement tool's mean length of AS-unit to measure length, clauses per AS-unit to measure subordination, and mean length of clauses to measure phrasal elaborations (Polat & Kim, 2013, pp. 192-193). To measure accuracy, Polat and Kim (2013) determined global accuracy by conducting an error analysis and exploring the linguistic measure of the participant's use of the present simple tense. According to Polat and Kim (2013), they wanted to implement different measures within each construct within the CAF triad to be able to get a more complete picture of the developmental trajectory for the participant, as different operationalizations of the construct will arguably capture different facets of language development Polat and Kim (2013, p. 186). Polat and Kim (2013) conclude that the findings in the study are similar to previous studies conducted within the area (Larsen-Freeman, 2006; Spoelman & Verspoor, 2010; Verspoor et al., 2008). However, when considering the developmental trajectory of the CAF measurements utilized in this study, it is clear that the participant's syntactical complexity and lexical diversity improved significantly, whereas the development with the measurements utilized in the accuracy construct was arguably somewhat limited.

In the quantitative case study "Dynamic development of complexity and accuracy: A case study in second language academic writing", Rosmawati (2014) utilized a time-series approach to examine the developmental trajectory of a single participant over the time period of one academic semester. Rosmawati (2014, p. 81) attempts to explain how the construct's complexity and accuracy develop in L2 academic writing and how the constructs interact with each other over time. Rosmawati (2014) coded the complexity construct by examining the two complexity traits, overall grammatical complexity and syntactical diversity. These traits were measured by a frequency count of sentence type to measure syntactical diversity and a Word/Finite Verb ratio to measure the participant's overall grammatical complexity (Rosmawati, 2014). The accuracy construct was coded by examining the accuracy traits error types and overall accuracy ratio. The error types were coded using the categories Global Error, Local Errors, and Mechanical Errors, as used in the 2013 study by Thewissen (Rosmawati, 2014). The overall accuracy trait was measured by the ratio analysis Error-Free Clause/ Clause (a more in-depth overview of measurements can be found in Table 3, as this master's thesis will also utilize the same measurements). Rosmawati (2014) argues that it is clear that the participant in the study experiences a developmental trajectory that can be categorized as dynamic and non-linear, which Rosmawati (2014) argues are in line with previous studies conducted by researchers such as Spoelman and Verspoor (2010) and Polat and Kim (2013). Rosmawati (2014) argues further that due to the fact that the data does not show a single direction of development and that each measure utilized in this study has its own pattern makes each learner idiosyncratic. Rosmawati (2014, p. 92) concludes that due to the fact that the constructs have an unpredictable developmental trajectory, there is no other way to describe the patterns that occur within the learner than dynamic. That is, that there is no such thing as a typical learner (Rosmawati, 2014).

Even though one could argue that CAF studies adopting a CDST perspective is a fairly new and small field within English linguistics, there is still a wide array of studies that explores this phenomenon. Researchers such as Vercellotti (2015) and Barrot and Agdeppa (2021) have recently attempted to further investigate the constructs within the CAF triad as an index of language development and language performance. Vercellotti (2015) aims to investigate two things in her 2015 study "The Development of Complexity, Accuracy, and Fluency in Second Language Performance: A Longitudinal Study". The first aspect Vercellotti (2015)wanted to investigate is to describe the developmental trajectories of oral language performance in light of the CAF triad. Firstly, Vercellotti (2015, p. 7) chose to investigate the complexity construct by investigating grammatical complexity and lexical variety. Secondly, the accuracy construct

was measured as the percentage of error-free clauses. Lastly, the fluency construct was measured with the measurement mean length of pause (Vercellotti, 2015). The second aspect Vercelloti wanted to investigate is if the developmental trajectory reveals any trade-off in the development of construct within the CAF triad or if it is a supportive relationship between the construct in the CAF triad. The aspect of trade-offs is arguably an accepted limitation in L2 performance, where one could argue that there is some form of competition for attentional resources when performing language tasks (Vercellotti, 2015). Vercellotti (2015, p. 14) found that most of the construct had linear change trajectories. That is, that the participants in this study experienced an improvement in all CAF constructs. Further, Vercellotti (2015) found in her study that there were no negative influences between the constructs within the CAF triad. A result that is arguably surprising. However, Vercellotti (2015) does state that the different scales of measurement utilized in this study can make it hard to draw comparisons and interpret the result (Vercellotti, 2015, p. 15).

The study "Complexity, accuracy, and fluency as indices of college-level L2 writers' proficiency" conducted by Barrot and Agdeppa (2021) is arguably one of the bigger studies which utilize the constructs within the CAF triad to gain a deeper insight into how the constructs interact with each other. The goal of the study was to investigate what CAF measures distinguish between proficiency levels and what is the strength of the relationship within the CAF measures Barrot and Agdeppa (2021, p. 4). This study stands out because Barrot and Agdeppa (2021) focuses on CAF constructs as an index of proficiency rather than an index of language development. Research that focuses on this particular aspect is not required to follow the same language learners over time because they can use samples from learners, in this instance more than 5000 college-level essays from the International Corpus Network of Asian Learners of English, from different proficiency levels (Barrot & Agdeppa, 2021). The complexity construct was measured using 14 indices, some of these indices are overall sentence complexity, length of production unit, and degree of phrasal sophistication (Barrot & Agdeppa, 2021, p. 5). The accuracy construct was measured by using the three steps in the WCR; clause boundary identification, clause categorization, because these rating takes error severity into account. The fluency construct was measured by computing the W/Tx, T/Tx, and C/Tx by using the automated tool L2SCA (Barrot & Agdeppa, 2021, p. 5). Barrot and Agdeppa (2021) conclude that it is clear that an interaction exists between language proficiency and the CAF measures used in their study. This means that one could distinguish proficiency level by examining, for example, length of production unit indices such as mean length of sentences and mean length of clause (Barrot & Agdeppa, 2021, p. 9). However, even though an

interaction does exist, it is clear that there are some limitations in this study. Barrot and Agdeppa (2021) point out that they do not examine the intra- and inter-variation of the participating countries in the study, which Barrot and Agdeppa (2021) argue might provide a deeper insight into the participant's proficiency level in light of their respective L1 background.

3 Method

This master thesis is a quantitative case-study that investigates the emergent dynamicity of eight tenth grader´s written production during their time in lower-secondary school grades eight to ten. This master thesis will measure learners' English writing development during this three-year timeframe by utilizing two facets of CAF construct, viz. accuracy and complexity. We have decided to eschew the fluency construct in this master`s thesis since the fluency construct is mainly measured by investigating factors such as native-like text production through speed and eloquence which is difficult to measure after-the-fact. Thus, we were not in a position to probe into the developmental trajectory of the learner`s fluency (Housen et al., 2012, p. 4).

This master thesis has adopted a panel design, which is a method design that allows for a sampled group of individuals to be measured for several variables, at several points in time (Hiver & Al-Hoorie, 2020). This successive measuring of variables then makes the longitudinal changes or stability available for assessment. For this thesis, the sampled group is comprised of the participating learners, and the variables that are to be measured are two of the constructs from the CAF-triad; complexity and accuracy, and the points in time will be the number of samples collected per individual. Each individual has provided ten written texts, where four are from eighth grade, four are from ninth grade and two are from tenth grade. Before delving into the methodology used in this master's thesis, it is necessary to clarify some issues regarding the theoretical framework used in this thesis, and the definitions of the CAF constructs.

Firstly, we must distinguish how using CDST as a theoretical framework will deviate from more common quantitative approaches in second language studies. For instance, the reductionist approach relies on the principle that to understand a concept, or in this case systems, one should take the object of inquiry apart and examine the sub-parts individually (Larsen-Freeman & Cameron, 2008, p. 201). However, from a CDST perspective, knowing the individual parts is not enough because when using CDST as a theoretical framework we are interested in finding out how the interaction between the different parts pave the way for new patterns of behaviour (Larsen-Freeman & Cameron, 2008). According to Larsen-Freeman and Cameron (2008, p. 201) there is an understanding that complex systems are interconnected. Due to this understanding, it might be hard or even impossible to explain the behaviours that arise within complex systems. The unpredictable nature of behaviour, according to Larsen-Freeman and Cameron (2008) also highlight a weakness in traditional research traditions, such

as the reductionist approach, because even if it is possible to know the behaviour of individual objects it is simply impossible to make consistent predictions of the individual objects contribution to a larger system over time. Whereas some traditional research methodologies might try to predict behaviour, methodologies that are built upon CDST try to retrodict behaviour within a complex system under investigation, in this case learners' writing trajectory over a three-year period.

Secondly, we must address the main challenges of implementing the CAF triad as a means to investigate the English writing trajectory for lower secondary school learners who participated in this research project. There seems to be a consensus within the research community that the constructs within the CAF triad have the potential to be an excellent tool for measuring developmental writing and being major research variables in applied linguistics in general (Housen & Kuiken, 2009). Larsen-Freeman (2009, p. 580) argues that the implementation of a developmental index, such as the CAF triad, will give researchers the opportunity to utilize an established repertoire that would go beyond the costumery practices of using vague terms, such as "advanced" and "intermediate", to describe the participants in a study. However, there are some clear shortcomings when it comes to using the CAF triad as research variables in a research paper such as this master's thesis, and a lot of empirical CAF literature has been critiqued of taking a reductionist approach when utilizing the constructs within the CAF triad in a practical manner (Housen & Kuiken, 2009).

The issues that might arise in working with the CAF constructs are mainly the issues in defining and limiting the reach of each construct. There is also the inevitable question of how outside factors, such as how planning and motivation affect learners' results. This master thesis will naturally consider these issues, but the thesis will mainly focus on the issue of providing a single unifying definition of the constructs within the CAF triad. We would like to consider outside factors that do affect learners' writing performance. However, in this study, this is not something that is viable, nor was it our purpose to investigate such factors to begin with. Due to the fact that we were not present during the pre-planning stage, writing stage, and post-writing stage, it is simply impossible to gain insight into how these factors affected the final written product provided to us for analysis. Rosmawati (2014) writes in her paper that the main hurdle to overcome is the challenge of finding and using a single unifying definition of the constructs in the CAF triad, especially in studies using CAF to investigate the dynamicity of a complex system (Rosmawati, 2014). This has led to the fact that many L2 studies using CAF either define the construct in a general manner or fail to explicitly define what the construct's complexity, accuracy, and fluency actually entails (Housen et al., 2012). This master thesis

must therefore invoke a consistent and clear definition of how each construct is used in an operationalised manner in this master's thesis.

3.1 Definitions and Limitations Complexity, Accuracy and Fluency (CAF) as a Construct

The next section of the paper will try to create a clear definition that this master thesis will consistently follow. Due to the fact that this master's thesis is largely informed by a study conducted by Rosmawati (2014),it will base its definition on how Rosmawati (2014) defined each construct. This is largely due to the notion Larsen-Freeman (1978) presented in her article "An ESL Index of Development", where she argued for the need for a common developmental yardstick that researchers can use to gauge learners' proficiency.

Complexity is arguably the most challenging construct to define and use in a practical setting. Ellis (2003) defines complexity as "the extent to which the language produced in performing a task is elaborate and varied" (Ellis, 2003, p. 340). This definition needs to be elaborated due to the fact that the complexity construct contains complex subsystems that need to be distinguished and this definition is a good example that highlights the issues within SLA research where researchers might use vague definitions that fail to highlight the complexity that makes up the constructs within the CAF triad. According to Housen et al. (2012) these vague definitions have a tendency to be used interchangeably in research literature. Therefore, we must propose a consistent definition that will help us in this master's thesis and further research within the field of writing development using constructs such as complexity and accuracy.

Due to the multidimensional nature that makes up the subsystems within the complexity construct, researchers such as Wolf-Quintero et al. (1998). Housen et al. (2012) and Wolf-Quintero et al. (1998) propose several additional terms that highlight and describe different aspects that make up the complexity construct in a better way than a general and singular definition that will undoubtedly limit the true scope of the complexity construct. Wolfe-Quintero et al. (1998) describe the complexity construct in two parts; grammatical complexity and lexical complexity. Grammatical complexity, according to Wolf-Quintero et al. (1998, p. 69), is primarily manifested through the variety of both sophisticated and basic systems a learner utilizes in sentence production. Whereas lexical complexity measures "the possession of a reasonably large lexicon" as this is an indication of a learner's productive vocabulary (Wolfe-Quintero et al., 1998, p. 101). However, this master thesis will mainly utilize the

definition provided by (Housen et al., 2012). , where complexity is divided into linguistic complexity and cognitive complexity. These concepts have a tendency to be used interchangeably in research literature due to the fact that the two concepts do interact with each other (Housen et al., 2012). However, it is crucial to distinguish the two concepts because the notion that makes up cognitive complexity relies heavily on concepts that are relative and subjective. Cognitive complexity refers to "the relative difficulty with which language elements are processed during L2 performance and L2 learning, as determined in part by learners' individual backgrounds" (Housen et al., 2012, p. 4). This definition includes, for example, the learner's aptitude for language learning and the learner's motivation for language learning. In comparison, linguistic complexity is object given and relies to a greater extent on how learners tackle intrinsic formal or semantic-functional properties of L2 elements (Housen et al., 2012, p. 4). When measuring a learner's linguistic complexity, the results measured are independent of the learners' aptitude and motivation for learning an L2.

The accuracy construct is arguably the simplest and most internally coherent construct used in the CAF triad (Rausch, 2012). Foster and Skehan (1996) define the accuracy construct as "freedom from error" and refers to the degree of deviancy from particular norms in the target language (Housen et al., 2012, p. 463). These particular norms are mainly made up of lexical and grammatical phenomena. However, this is arguably a simplistic view of the accuracy construct, and researchers such as Housen et al. (2012, p. 4) argue that tirelessly adhering to the strict notions of grammatical and lexical phenomena in a target language will not necessarily lead to a greater understanding of learner's accuracy development. One should also consider the relative nature of the errors made by a language learner (Housen et al., 2012, p. 4). Housen et al. (2012, p. 4) further argue that one should also consider the appropriateness and acceptability of errors made in light of the learners' context. An example of this is during the process of automatizing language features there are potential trade-offs between speed and accuracy, and further, there are situations where non-standard usages of phrases are acceptable to use in certain social situations (Housen et al., 2012, p. 4; Wolfe-Quintero et al., 1998, p. 3).

Fluency is a fairly straightforward construct that measures how comfortable a language user is with producing, in this case, written work. Traditionally this has been measured through factors such as native-like text production through speed and eloquence (Housen et al., 2012, p. 4). However, fluency is multidimensional in nature and can be categorized into the three subdimensions speed fluency, breakdown fluency, and repair fluency (Housen et al., 2012, p. 5).

3.2 Participants

The participants in this master's thesis consist of eight tenth-grade learners. The prerequisite for the selection of each participant was that the learner should be an L2 English learner attending tenth grade in a Norwegian school context. Further, there was a requirement on behalf of the school, as we relied on the learners' written production to be saved up over a period of at least three years. After a long process of finding a willing and suitable school to collaborate with us, we were able to gain informed consent from 10 learners. Among these 10 learners, some of the written work was missing, resulting in 2 learners being omitted due to lack of complete data. Thus, 8 participants were suitable subjects for this research project.

3.3 Sampling and Coding

The samples themselves are written texts written by learners over the course of three years. We have not designed the tasks, and they are thus to be considered authentic written work produced by these learners. We recognize that there might have been subtle differences in the task design and the context in which they were written, which in turn might have had an impact on the learner's performance (Thelen & Corbetta, 2002, p. 61). Larsen-Freeman (2006) was able to somewhat avoid this issue in her study, by adding a repetitive task feature. However, this feature presents a new challenge, since the repetition of tasks makes determining performance differences more difficult, since complexity generally improves with repetition (Larsen-Freeman, 2006). Nevertheless, we were able to avoid the probable negative correlation between some of the measures we intend to employ and text length (Wolfe-Quintero et al., 1998), and thus 200 words of each text sample will be extrapolated for further analysis, omitting direct quotations.

Each of the constructs within the CAF triad (e.g., Complexity and Accuracy) has been analysed using two types of measures per construct: both a frequency count and a ratio measure. The complexity construct has been analysed by looking at syntactical diversity and overall grammatical diversity. The syntactical diversity was measured by coding each sentence in the data using definitions provided by Verspoor and Sauter (2000): simple (Si), compound (Co), complex (Cx) and compound-complex (CoCx). Each sentence type was then counted, the objective being that the distribution of the different sentence types would describe the syntactical diversity, thus expressing the complexity of the text. The grammatical complexity

was analyzed engaging a word per finite-verb ratio (W/FV). Other commonly applied indices including MLT (Mean Length of t-units) and DepC (Dependent Clause for subordination amount) were considered, but not applied following the argument made by Verspoor et al. (2008) and the argument made above, that separate indices are incapable of incapsulating the full extent of complexity. The W/FV ratio thus provides a good measure of grammatical complexity as it contemplates subordination, coordination and complex noun structures (Rosmawati, 2014).

The accuracy trait was analyzed by investigating types of error and the frequency of each type, and by the ratio of error-free clauses per clause. The errors were coded utilizing the 7 main categories provided in the Louvain error tagging taxonomy (see Table 1), before being tallied (Granger et al., 2022). The Louvain error tagging taxonomy is one of the most robust and well documented error tagging systems and was thus used in the present study. The Louvain error tagging taxonomy is employed in numerous other studies, where accuracy constructs are being examined. In spite of the taxonomy providing 54 different error types, we have limited our analysis to the 7 main categories of the taxonomy. The rationale for this limitation is directly correlated to the purpose of the research itself, which seeks not to dissect the individual constructs, but rather to examine their interaction over time. As demonstrated by Rosmawati (2014) the 7 main categories of errors, were then combined into three categories, expressing the level/dimension in which the error lies; namely Global, Local and Mechanical errors. Errors spanning the entire clause, and subsequentially the whole sentence, were marked as Global (GE). Errors occurring on a phrasal level, with ensuing effect on a word, lexical and lexico-grammatical level were marked as Local (LE). Lastly, errors in punctuation and formal errors were marked as Mechanical errors (ME). Clauses containing no errors were marked as error-free clauses (EFC). Within each text sample, the number of clauses will be counted as well as the EFC, to obtain the EFC/C ratio. Jiang (2013) posits that the EFC/C measure provides deep insight into the learners' written production, in terms of accuracy.

Table 2: Overview of Louvain Error Tags

Error Tag	Definition	Description
F	Formal Errors	Spelling and morphological errors that result in a non-existent English word (+ homophones).
G	Grammatical Errors	Errors that break the general rule of English grammar.
L	Lexical Errors	Errors involving the lexicosemantic properties of words or phrases (conceptual, collocational, or connotative).
X	Lexicogrammatical Errors	Errors that violate the lexicogrammatical properties of words (i.e. erroneous dependent prepositions, erroneous complementation).
Q	Punctuation Errors	Errors that target punctuation problems (e.g. confusion between punctuation markers, missing or redundant markers.
W	Word Redundant/Missing/Order Errors	Unnecessary use of words, missing necessary words, or misorderd words.
Z	Infelicities	Register problems, questions of political correctness and stylistic problems.

(Adapted from Granger et al., 2022)

Table 3. Complexity and Accuracy Measures

Measures	Frequency Counts	Ratios
COMPLEXITY	Sentence Types: • Simple (Si) • Compound (Co) • Complex (Cx) • Compound-complex (CoCx)	Word/Finite Verb (W/FV)
ACCURACY	Error Types: • Global Errors (GE → grammar and infelicities) • Local Errors (LE→ word, lexical & lexico-grammar) • Mechanical Errors (ME→ form & punctuation)	Error-Free Clause/Clause (EFC/C)

(Rosmawati, 2014, p. 84, adapted to new version of error tagging manual)

3.4 Statistical Procedures

Both descriptive analysis and correlation analysis were applied subsequent to coding. Each stage of coding aligned with and sought to answer the research questions.

To visualize the dynamicity along the developmental trajectories of each learner, the data were plotted in graphs. To illustrate the dispersion of sentence types and error types in the text samples, distributional bar charts were used. The descriptive stage of analysis explored the nature of accuracy and complexity, thus answering the first of the two research questions.

Then a correlation analysis was carried out in order to investigate the interaction between accuracy and complexity. First, a moving average smoothing method was employed in order to account for the non-linear character of the data and to encapsulate broad trends (van Geert & van Dijk, 2002; Verspoor & Dijk, 2013). Then, for comparison reasons, both data sets were normalized. Lastly, a 3-window moving correlation analysis was implemented. This

allowed for the exploration of the interaction and relationship between the two constructs and thus answered the second research question.

3.5   Research Ethics

The collection of any data that can be linked to a person is considered personal data and necessitates approval from the Norwegian Centre for Research Data (henceforth, NSD) in order to ensure that ethical and legal guidelines are followed. The data collected in this project consists of a collection of learner-produced texts, organized by the participating learners' names. The data could also contain personal information, as we did not have any control over the task designs that the learners were initially responding to. Despite the personal information not being of any importance or interest in this master's thesis and the anonymization during processing, approval from NSD was indeed necessary. The learners whose texts we collected are under the age of consent, meaning that it requires parental consent. We applied to NSD in the spring of 2022 and got approval to conduct our research by collecting learners' written work (See appendix 1).

3.6   Quality within the Study

It is crucial to consider the validity and reliability of the data when conducting a quantitative case study. Generally, reliability refers to how well results remain consistent over time and how accurately they reflect the entire student body (Golafshani, 2003). It is necessary for the research methodology to be reproducible with similar results in future studies in order to be considered reliable and valid (Golafshani, 2003). Research validity refers to the accuracy and truthfulness of the results obtained from the research conducted (Golafshani, 2003).

There are three main limitations to this study. Its first limitation is the small number of participants and the small number of text samples it used (Golafshani, 2003; Rosmawati, 2014). We extracted 200 words (±10 percent), from each text in the purposive sampling, excluding direct quotes and dialogue. Having 8 participants, and each providing 10 samples, resulted in 16 000 words to be include in the corpus of this study. Still, the data analysed is fairly limited. The results, therefore, necessitate a corpus-based interpretation. In light of the limitations of this project and data set, there can be no generalized claims made outside of the scope of this project. Further studies and examinations are required to substantiate or falsify the results (Rosmawati, 2014) as with any study of similar nature.

Secondly, limitations are imposed by the coding of the data. A factor affecting the data's reliability is the absence of external coders. There is no subjectivity in the Louvain error tagging system, so specific data points might be confused about where they should be placed. In the ideal scenario, a competent external coder should have been utilised for such a project to avoid personal bias. A possible remedy would be that we code the data separately, then compare the coding, and lastly calculate the inter-coder reliability. However, due to limited time available to carry our study, this was not done.

Thirdly, the study has a methodological limitation related to the use of CAF. The numerous variables constituting the CAF triad make it moderately unreliable as a method. It is possible that data from different studies can differ because constructs are not defined specifically (Michel, 2018). A possible remedy would be to define the constructs more precisely and establish well-defined criteria for processing data in the CAF triad. It will, however, be challenging to define and develop a common empirical standpoint due to the multidimensional nature of the constructs and how those constructs are interpreted when processing data (Housen et al., 2012).

Another aspect of the study that strengthens the reliability and validity of this master's thesis is that the samples were collected over three years and that the texts have been produced under similar contexts – a learning context – without any mention of a study nor the pressure that a test setting ineluctably exerts on the learners. In our previous FoU (i.e., Bachelor's thesis) – we used texts written as half-term papers, where the prerequisites are practically identical. However, we had no insight into when the learners chose to hand in their work, and time pressure and a test scenario in and of itself could stress the learners to a point in which it significantly affects their performance.

Further research may be conducted in order to examine how complexity, accuracy, and fluency develop across grade levels. In order to understand the general projection of writing development throughout a learner's mandatory school years, one might compare the development of learners' English writing through different grade levels, such as 5-7 and 8-10.

Furthermore, we acknowledge that the use of "fluency" as a construct while working on written abilities comes with its own set of challenges. Researchers such as Wolfe-Quintero et al. (1998, p. 14) and Pallotti (2009, p. 591) argue that fluency is mainly measured by timing the participant's writing through measures such as the number of words per minute; it logically follows that this would have been impossible to conduct in our research.

4   Results

In Chapter 3 we presented and outlined the methodologies used to empirically investigate the developmental trajectory of complexity and accuracy. Further, we also presented where we recruited the participant and the criteria for selecting participants for this study. In this chapter, we will examine the developmental trajectory of eight tenth graders. The data is a collection of the participant's written work over a period of three years. Further, we will analyse the data in light of the research question posed in this master's thesis. The research questions in this master's thesis are as follows:

RQ1: How does Norwegian lower-secondary learners' written work develop in terms of complexity and accuracy over a three-year period?

RQ2: How does the measures of complexity and accuracy constructs interact with each other over a three-year observational period?

The first research question "How does Norwegian lower-secondary learners' written work develop in terms of complexity, accuracy, and fluency over a three-year period?" is arguably a fairly simple question to find an answer to. According to Housen et al. (2012, p. 2), the CAF triad can be used as the primary epiphenomena that highlight the psycholinguistic processes that underlie the processing, representation, and acquisition of L2 systems within an L2 learner. When considering the different constructs within the CAF triad we as researchers are able to make some general claims about how the learner develops over a certain time period. As mentioned previously the first research question is fairly due to the fact that we only want to examine how the construct's complexity, accuracy, and fluency develop over a three-year period on an intraindividual level. That is, by examining descriptive measures such as frequency counts and ratio analysis. However, an arguably greater challenge is to answer the second research question "How does the measures complexity, accuracy, and fluency interact with each other over a three-year observational period?".

The second research question focuses on how the constructs within the CAF triad interact with each other over a period of three-years. According to (Housen et al., 2012), the constructs within the CAF triad are distinct dimensions of L2 performance. However, this does

not mean that the constructs are not interrelated as such. There is a general consensus within the field that the constructs within the CAF triad do not develop collinearly and that the constructs within the CAF triad are somewhat competitive in nature (Housen et al., 2012). This means that an increase within the complexity construct could conceivably lead to a decrease in the accuracy construct. The second research question will attempt to investigate how the construct interacts with each other and if the constructs are independent dimensions or if they are mutually supportive, or if the construct in the CAF triad is competitive in nature (Housen et al., 2012).

In this chapter, we will analyse the participant´s texts by utilizing descriptive measures to answer the first research question and a correlation analysis to answer the second research question. Further, we will structure the descriptive measures by examining each construct individually. Firstly, we will examine the complexity construct by conducting a word/finite verb ratio to measure overall grammatical complexity and a sentence type analysis used to measure syntactical diversity. Thereafter, we will utilize descriptive measures to examine the accuracy construct by examining overall accuracy ratio and error types. Secondly, we will utilize a correlation analysis to attempt to answer the second research question. This was done by smoothing the data to gain an insight into general trends that arise within each participant and thereafter do a moving correlation analysis to explore the association between the construct's complexity and accuracy (Rosmawati, 2014).

4.1   Results 1: The Developmental Continuum of the Complexity Construct

Figures 1, 2, and 3 illustrate the developmental trajectory of the complexity construct over a three-year period for participants 3-10. By conducting a frequency count of the variable's word count and finite verb we will conduct a ratio analysis that provides us with the developmental trajectory of the overall grammatical complexity level of the participants within this study. An initial look at figures 1, 2, and 3 shows us figures where the variables fluctuate greatly. One could argue that this fluctuation does provide some evidence that the development of overall grammatical complexity shows signs of dynamicity and nonlinearity within all the participants in this study, and the trajectory line is characterized by a high variability along the trajectory line. Further in this section, we will conduct a deeper analysis of the overall developmental continuum for each of the participants in this study.

4.1.1 Overall grammatical Complexity

Figure 1: Word per Finite Verb

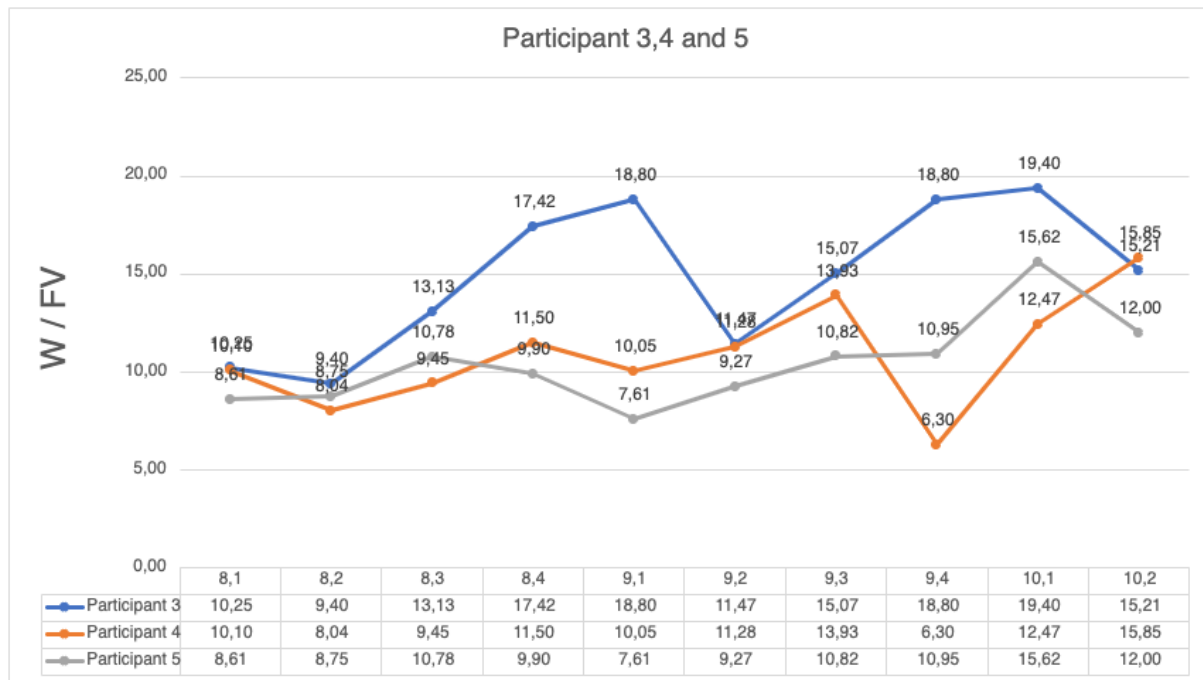|	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2
Participant 3	10,25	9,40	13,13	17,42	18,80	11,47	15,07	18,80	19,40	15,21
Participant 4	10,10	8,04	9,45	11,50	10,05	11,28	13,93	6,30	12,47	15,85
Participant 5	8,61	8,75	10,78	9,90	7,61	9,27	10,82	10,95	15,62	12,00

Figure 1 shows the developmental continuum of participants 3, 4, and 5. Participant 3 had an initial word/finite verb ratio of 10,25 in the first assignment in eighth grade. Throughout a three-year period, the ratio ebbs and flows. Participant 3 reaches a high level in complexity in the first assignment in tenth grade with a ratio of 19,40. During the three-year period, participant 3 has undoubtedly experienced an overall development within the category of overall grammatical complexity. The other participants in figure 1 also showed an increased level of complexity over a three-year period, where participant 4 started with a ratio of 10,10 in eighth grade and concluded with a ratio of 15,85 in the last assignment of tenth grade. Participant 5 had an initial ratio score of 8,61 in eighth grade and ended up with a ratio of 12,00 in the last assignment of tenth grade. All participants in figure 1 experienced high fluctuation, ebbs and flows within the developmental continuum of overall grammatical complexity.

Figure 2: Word per Finite Verb
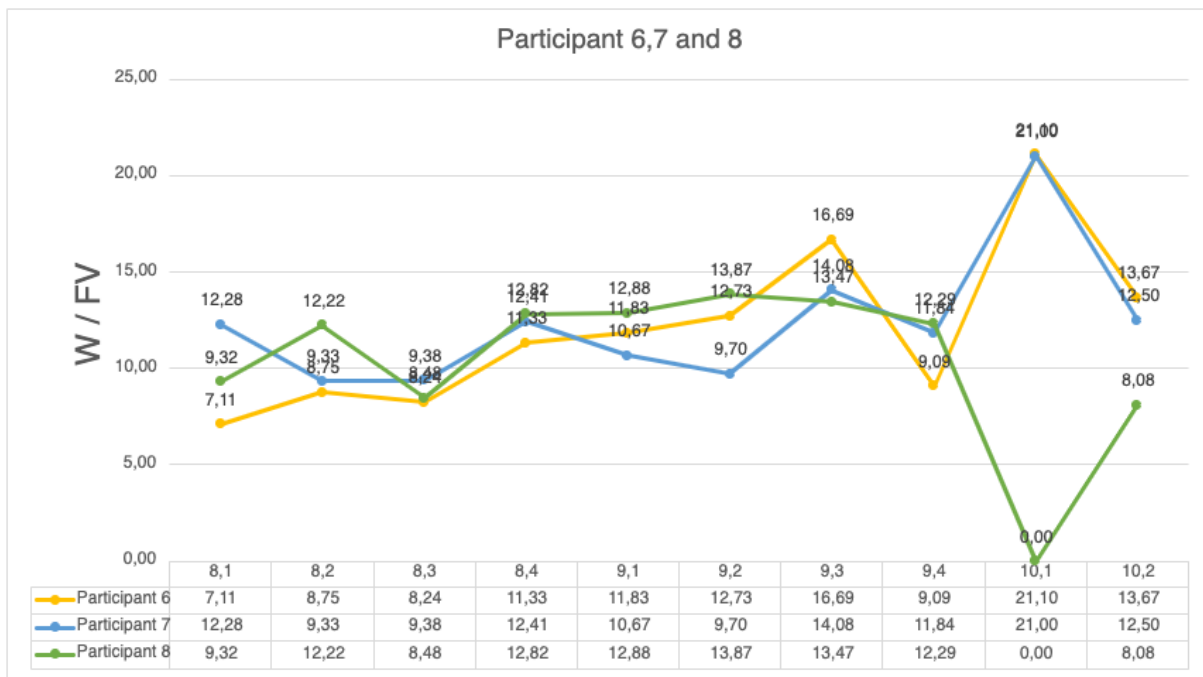
Figure 2 shows the developmental continuum of participants 6, 7, and 8. Participant shows a clear development within the complexity construct, where the initial ratio in the first assignment of eighth grade is 7,11, and the last assignment of tenth grade shows a ratio of 13,67. Participant 3 experienced a clear high in the first assignment of tenth grade where the ratio was 21,10. The other two participants on the other hand do experience development within the complexity constructs. However, the development experienced by participants 7 and 8 is arguably less than the developmental trajectory of participant 6. Participant 7 had an initial ratio of 12,28 in the first assignment of eighth grade and a final ratio of 12,50 in the last assignment of tenth grade, which means there was a complexity increase of 0,22 from the first assignment in eighth grade to the last assignment in tenth grade. Further, throughout the developmental continuum, participant 7 experienced high ebbs and flows through the three-year period. Participants experienced a similar development as participant 7.

Figure 3: Word per Finite Verb

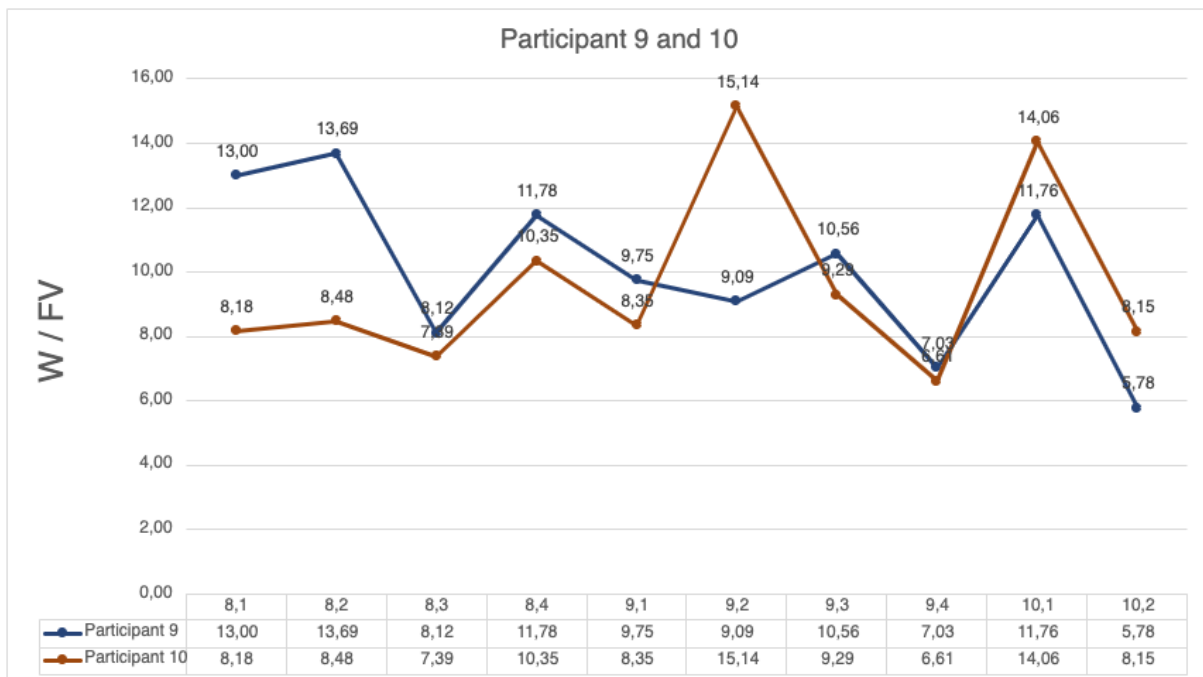|	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2
Participant 9	13,00	13,69	8,12	11,78	9,75	9,09	10,56	7,03	11,76	5,78
Participant 10	8,18	8,48	7,39	10,35	8,35	15,14	9,29	6,61	14,06	8,15

Figure 3 shows the developmental continuum of participants 9 and 10. The participants in figure 3 experienced an overall regression in the overall grammatical complexity from the first assignment in eighth grade to the last assignment in tenth grade. Participant 9 had an initial ratio in eighth grade at 13.00 and a ratio of 5.78 in the last assignment of tenth grade. Participant 9 experienced a high in the second assignment of eighth grade, further on the continuum participant 9 experienced arguably a continuous regression in the complexity construct throughout the three-year period. Participant 10 experienced an initial ratio of 8.18 in the first assignment of eighth grade and a ratio of 8.15 in the last assignment of tenth grade, which is a small regression. Participant 10 do have higher highs than participant 9 were participant 10 experienced a high point in the first assignment of tenth grade with a ratio of 14.06. When looking at the data set in figure 1, 2, and 3 several of the participants do experience some sort of regression in the overall grammatical complexity. However, according to de Bot (2008) an ebbing trend is arguably still an expression of overall language development.

4.1.2 Syntactical Diversity

Figure 4 through Figure 7 illustrates the complexity of the sentences produced by each learner, in the 10 sample texts. It is also evident that none of the learners had a balanced distribution of sentence types.

Figure 4: Sentence Type Distribution
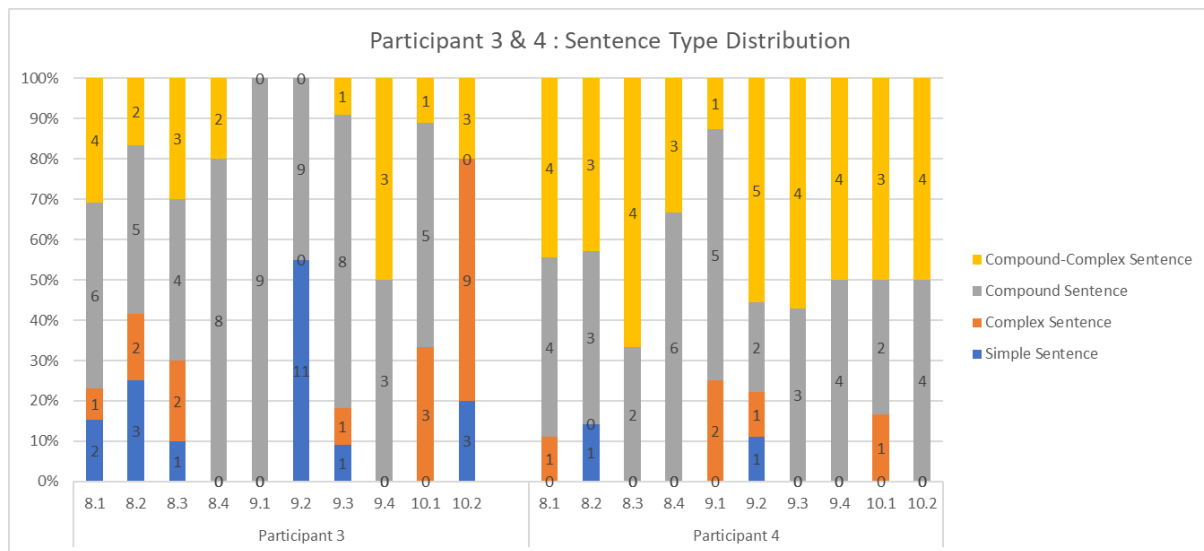
In the first three assignments, Participant 3 has a fairly low yet fluctuating presence of simple sentences, ranging between one and three. The two following assignments (8.4 and 9.1) has no simple sentences present, however there is a sudden and substantial spike of simple sentences in assignment 9.2, with 11 simple sentences. The subsequent assignment shows a decrease in simple sentences, similar to the presences of simple sentences in the first three assignments. In assignment 9.4 and 10.1 there are no simple sentences, before a small increase in the last assignment (10.2) with three simple sentences. The complex sentences are barely present in the first eight assignments; however, the participant experiences a substantial growth in the last two assignments, which have 3 and 9 complex sentences. Overall, the high level of complexity is revealed through the number of both compound and compound-complex sentences. In assignment 8.4 and 9.1, compound sentences account for 8 out of ten and 9 out of 9 sentences. Complex-compound sentences were present for most of the assignments, not including assignment 9.1 and 9.2.

The complexity of participant 4's writing is evident in the substantial presence of compound and complex-compound sentences. Overall, there were only two simple sentences (assignment 8.2 and 9.2). The number of complex sentences is comparatively low, ranging

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between one and two sentences. There seems to be a mutually exclusive relationship between the simple sentence category and the complex sentence category, as they are only present simultaneously in assignment 9.2. In five of the assignments there are exclusively compound and compound-complex sentences, which account for the high level of complexity of the participant's writing.

Figure 5: Sentence Type Distribution
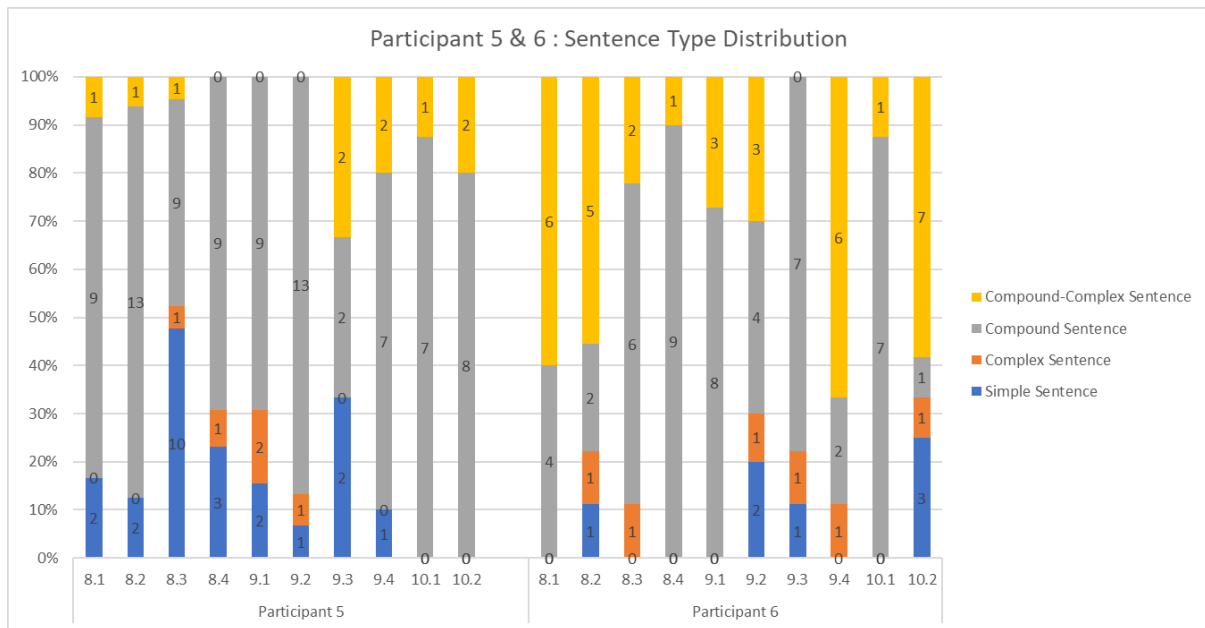
According to Figure 5 it is clear that participant 5 mainly writes compound sentences, where the number of compound sentences fluctuates between 7-13 compound sentences in each assignment with the exception of assignment 9.3, which only has 2 compound sentences. Further, it is apparent that the participant does not write many complex sentences in the assignments submitted in the whole three-year period, where the participant wrote 1 complex sentence in assignments 8.3, 8.4, and 9.2 and 2 complex sentences in assignment 9.1. The participant also utilizes some simple sentences throughout this three-year period. However, it is apparent that the participant throughout the whole three-year period becomes more complex and writes to a greater extent sentences such as compound-complex and compound sentences. An example of the increased complexity in the developmental trajectory is assignment 10.1 and assignment 10.1. In assignment 10.1 the participant wrote 7 compound sentences and one compound-complex sentence and in assignment 10.2 the participant wrote 8 compound sentences and 2 compound-complex sentences. Compared to the first assignment in eighth grade the participant does not utilize any simple sentences and has a high level in the use of

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compound-complex sentences. However, the total amount of sentences varies significantly from assignment to assignment. In assignment 8.3 the participant wrote a total number of 21 sentences, whereas in assignment 10.1 for instance the participant only wrote a total number of eight sentences.

The sentences produced by participant 6, mainly consist of compound and complex-compound sentences, with four assignments consisting exclusively of these sentence types. This depicts a high complexity level. Only four of the assignments contain simple sentences, varying between one and two simple sentences in assignments 8.2, 9.2, and 9.3, before it triples in assignment 10.2. The participant thus experiences an overall increase in the number of simple sentences. The number of complex sentences never reaches higher than one sentence in the assignments such sentence type is present, which also coincides with the presence of simple sentences, as all of the assignments containing simple sentences also contain complex ones. Only in assignment 8.3 and 9.4 is complex sentences present without simple sentences. The compound sentences vary greatly through the assignments, ranging from one to nine sentences. There seems to be a slight decrease form the first assignment (8.1) to the second assignment (8.2) before a steady increase towards the peak in compound sentences is reached in assignment 8.4 with 9 compound sentences. It then decreases over the next two assignments (9.1 and 9.2) before it takes on a more noticeable fluctuation pattern over the last four assignments with 7 compound sentences in assignment 9.3, followed by 2 in assignment 9.4, again followed by 7 in assignment 10.1 and lastly 1 compound sentence in assignment 10.2. The participant use of complex-compound sentences decreases over the first four assignments, from 6 sentences to 1 sentence in assignment 8.4. It increases slightly, to 3 compound-complex sentences in the following two assignments (9.1 and 9.2). And in the last four assignments, the presence of compound complex sentences is highly unstable, comparable to the presence of compound sentences. However, the increase of compound sentences results in a decrease in complex-compound sentences, and vice versa in these last four assignments. In assignment 9.3 there are no complex-compound sentences present, but the following assignment has 6 compound-complex sentences. Then again, in assignment 10.1, the complex-compound sentences are absent before it in the last assignment (10.2) reaches an all-time high of 7 sentences.
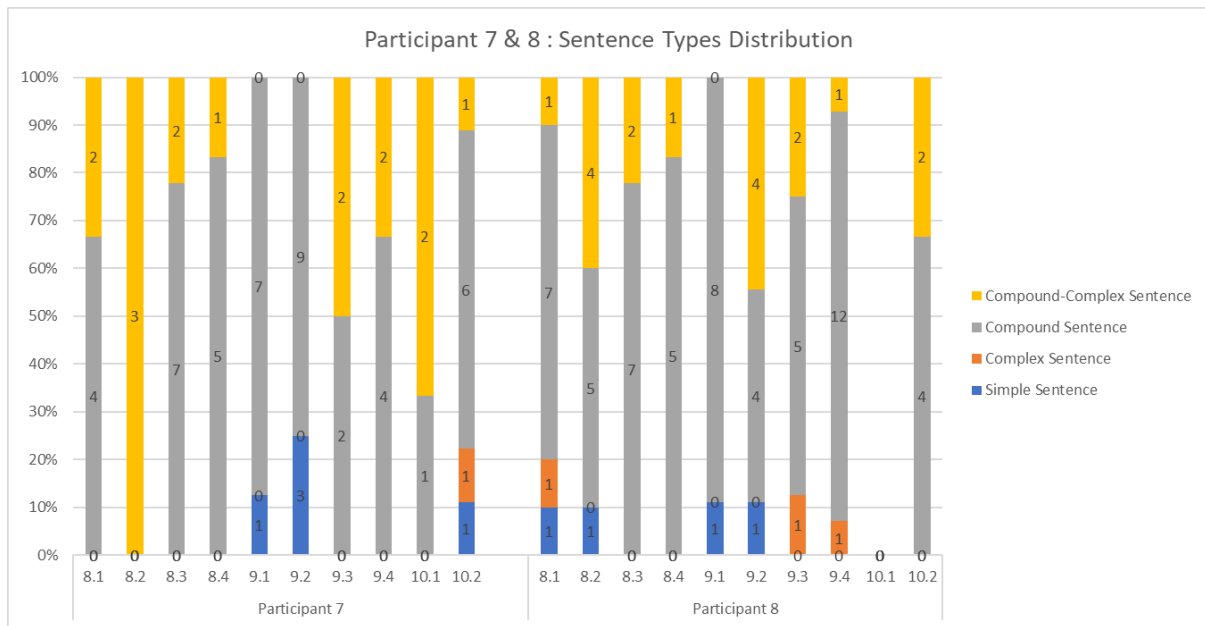
Figure 6: Sentence Type Distribution

Figure 6 exhibits the sentence type distribution of participant 7 and 8. The writing of participant 7 is characterised by an overall high degree of complexity. Simple sentences are only present in assignment 9.1, 9,2 and 10.1; the first and last of these assignments both contain one simple sentence each, whereas assignment 9.2 contains three times as many simple sentences. Only in the last assignment 10.2 are complex sentences present, counting one complex sentence. Another aspect worth noticing is the vast variability in number of sentences per assignment for participant 7, ranging between 3 sentences (8.2 and 10.1) and 12 sentences (9.2) per assignment. In assignment 8.1, participant 7 has 4 compound sentences, whereas in the following assignment the presences of compound sentences is lacking. Over the next four assignments the number of compound sentences alternates between increasing and decreasing, before the number of compound sentences reaches its maximum of 9 sentences in assignment 9.2. The alternation of increase and decrease continues, however the number of sentences is lower compared to assignments 8.3 - 9.2, where the lowest number of compound sentences were 5 and in assignments 9.3-10.1 it was as low as 1. Towards the last assignment, the increase is the most striking, increasing with 5 sentences. Compound-complex sentences increases slightly from the first assignment to the second assignment, before it steadily declines over the next couple of assignment and ends up being completely absent in both assignment 9.1 and 9.2. For the subsequent three assignments (9.3-10.1) the number of compound-complex sentences remain the same, before it decreases again towards the last assignment.

A first glance at the sentence type distribution of participant 8 reveals that compound sentences accounts for most of the sentences written. In each of the assignments the compound sentences make out the majority of the sentences. In assignment 8.1, there are seven compound sentences, which decreases to 5 sentences in the subsequent assignment (8.2) before it increases back up to seven sentences in assignment 8.3. The same alternation between increase and decrease continues, however with varying intervals, before the number of compound sentences reaches its overall highest number, with 12 sentences in assignment 9.4. Compound-complex sentences are present in all assignments, apart from assignment 9.1, in which it is absent. The first assignment has one compound complex sentence, whereas the second assignment (8.2) has four. In the subsequent two assignments the number of compound-complex sentences steadily decreases. In assignment 9.2 the number of compound-complex sentences is back up at four sentences, before it yet again decreases over the new to assignments (9.3-9.4). In assignment four there are 2 compound-complex sentences. The presence of both of these sentence types, and the extent of their presence accounts for the overall complexity of participant 8, throughout the three-year period. However, both simple sentences and complex sentences are present in the writing of the participant. Simple sentences are only present one sentence at a time, and only in four of the assignments, the first two assignments in both eighth and ninth grade. Complex sentences are also present only one sentence per assignment, and are present only in assignment 8.1, 9.3 and 9.4. Only in the first assignment are simple sentences and complex sentences present at the same time.

Figure 7: Sentence Type Distribution
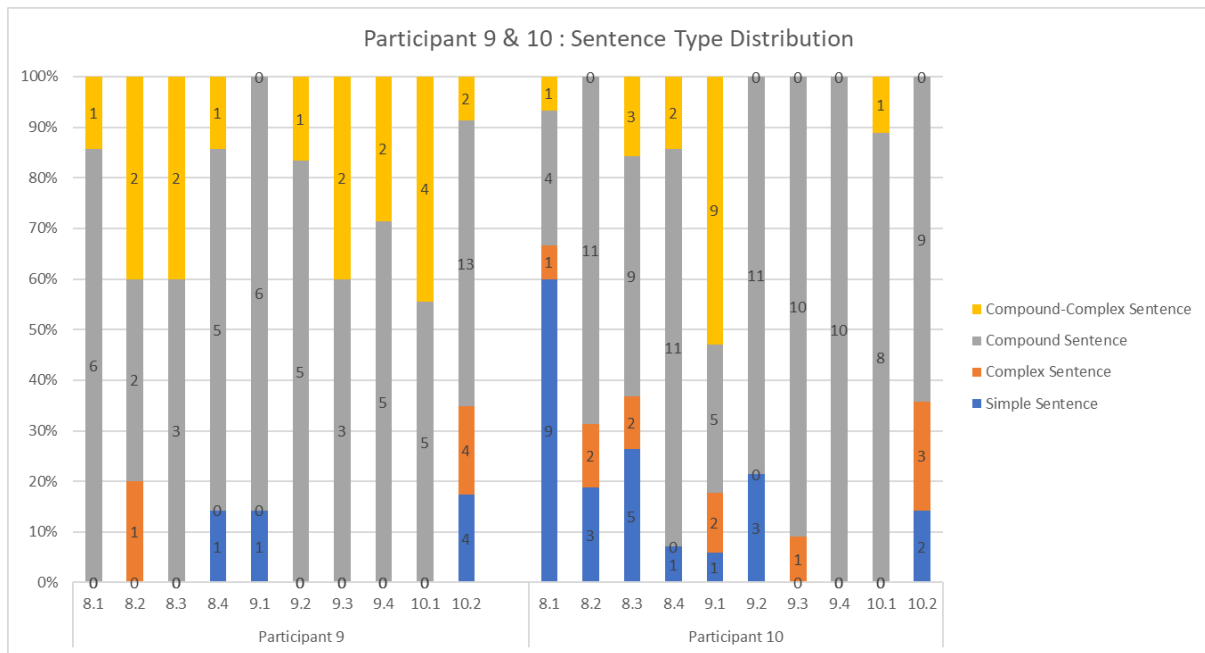
According to Figure 7, participant 9 has an arguably high degree of complexity in the types of sentences used, where the participant mainly utilizes compound sentences and compound-complex sentences. However, it is also apparent that the participant writes fewer and longer sentences in a majority of the assignments submitted in this study. For instance, in assignments 8.3 and 9.3 the participant only wrote 5 sentences, and in the rest of the tasks submitted the participant wrote in the range of 7 sentences. However, in the last assignment of tenth grade the participant wrote a total number of 23 sentences, where the vast majority of the sentences were compound sentences. Further, the participant do not utilize many simple and complex sentences. Throughout every assignment submitted the participant only wrote a total of 6 simple sentences and 5 complex sentences, where a majority of these sentences were written in the last assignment of tenth grade. Overall, the participant exhibits generally high complexity throughout a three-year period.

As presented in Figure 7, participant 10 has arguably developed a more complex language throughout the three-year period. Initially, in the first assignment of eighth grade, the participant had a total number of 15 sentences, where 9 are simple sentences, 4 are compound sentences, and lastly the participant had 1 complex and compound-complex sentence. Compound-complex sentences are mostly present in the first half of the assignments, with one sentence in assignment 8.1, three sentences in assignment 8.3, 2 sentences in assignment 8.4, before the overall highest number of compound-complex sentences were reached in assignment

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9.1 counting 9 sentences. In the second half of the assignments, only assignment 10.1 had one compound-complex sentence. The number of simple sentences varies greatly, but overall decreases over the three-year period, not even being present in assignments 9.3, 9.4, and 10.1, before the last assignment where there were two simple sentences. The number of simple sentences in each assignment is also relatively low (less than 3), not counting assignments 8.1 and 8.3. Compound sentences make out a substantial part of the sentences written by the participant, with only two assignments having a compound sentence count below 5 (assignments 8.1 and 9.1), and the other assignments ranging between 8-11 compound sentences each. The overall presence of complex sentences is the least substantial of all the sentence types, with assignments 8.1 and 9.3 having one complex sentence present each, assignments 8.2, 8.3, and 9.1 counting two complex sentences each, and the last assignment counting three complex sentences (10.1). Which leaves four of the assignments without complex sentences. Overall, the figure portrays how the participant's overall complexity increased in the first half of the time period, before a slight decrease in the last assignment.

4.2   Results 2: The developmental Continuum of the Accuracy Construct

The ratio analysis of error-free clauses and total clauses provides us with insight into the dynamicity of the accuracy construct. Figures 4, 5, and 6. Illustrate the developmental trajectory of the accuracy ratio for the participants in this master's thesis. A brief look at Figures 4, 5, and 6 does give us the impression that the developmental trajectory the participant's experience varies significantly.

Figure 8: Error-Free Clauses to Total Clause Ratio
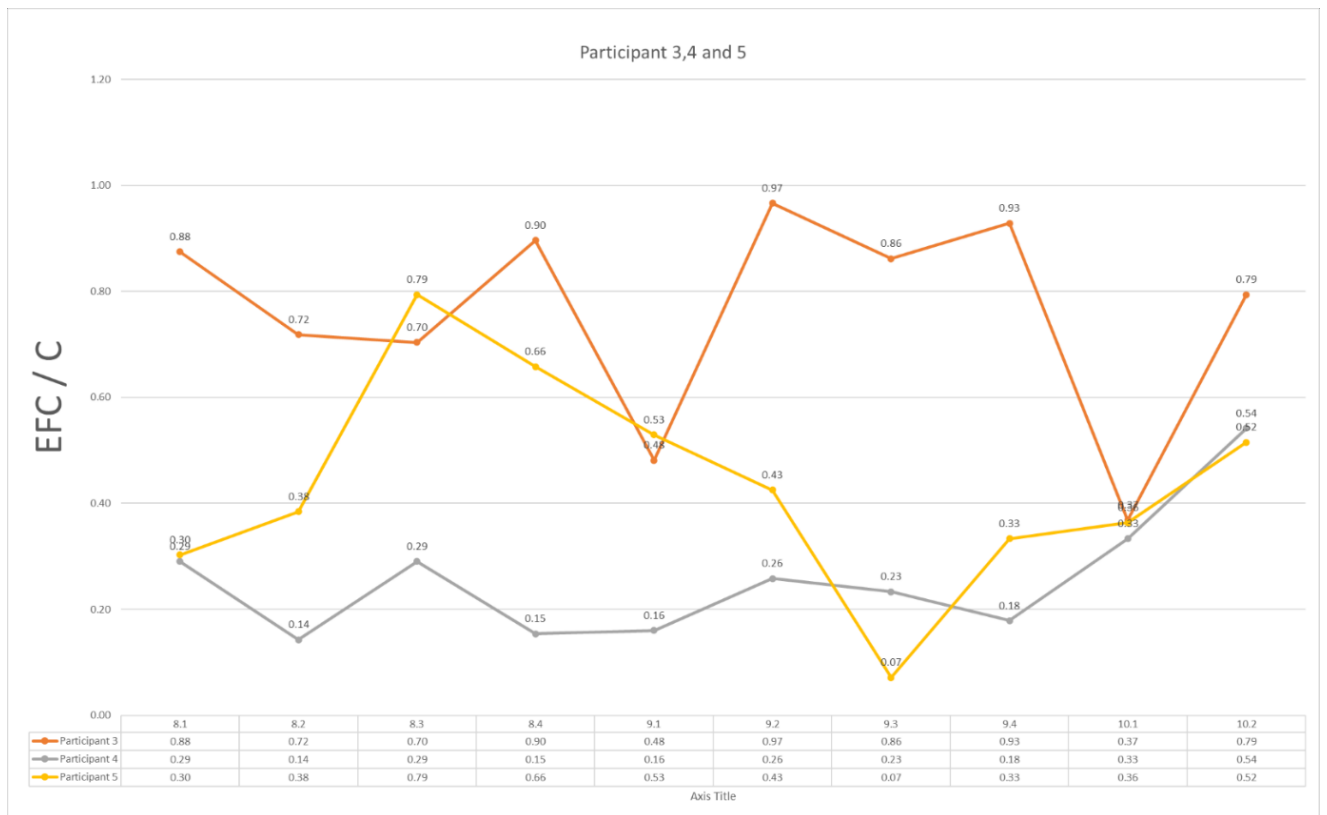
Figure 1 illustrates the developmental trajectory for participants 3, 4, and 5. It is clear that the participants experience a different developmental trajectory throughout their three years in secondary school. Participant 3 had an initial ratio of 0,88 in the first assignment of eighth grade. Participant 3 experienced a developmental trajectory that is in line with the dynamic nature of the constructs within the CAF triad. Participant 3 experiences small ebbs throughout eighth grade and reaches a high in ninth grade with a ratio of 0,97. In the last assignment of tenth-grade participant 3 had a ratio of 0,79, which is a decline compared to the first assignment in eighth grade. Participant 5 follows a similar trajectory to that of Participant 3. Participant 4, on the other hand, had a developmental trajectory that is to a greater extent similar from assignment to assignment and experiences arguably a small but steady increase within the accuracy construct from assignment to assignment, where participant 4 had an initial ratio of 0,29 in eighth grade and ended up with a ratio of 0,54 in the last assignment of tenth grade.

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	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2
Participant 6	0,44	0,82	0,53	0,52	0,39	0,47	0,59	0,33	0,35	0,53
Participant 7	0,14	0,16	0,18	0,19	0,50	0,75	0,10	0,28	0,08	0,42
Participant 8	0,13	0,22	0,20	0,13	0,26	0,38	0,20	0,15	0,00	0,19
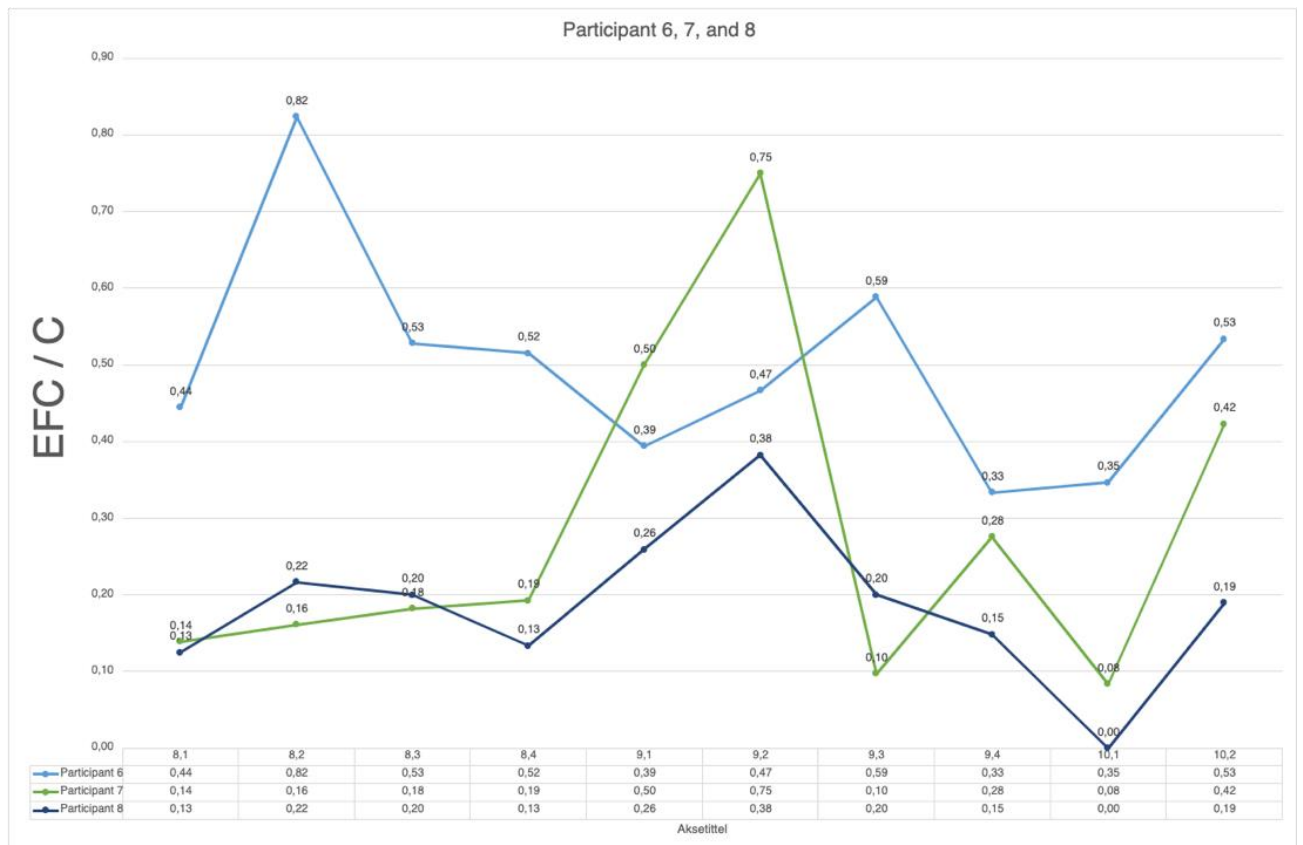
Figure 5 showcases the developmental trajectory for participants 6, 7, and 8. Participant 6 experiences an initial ratio of 0,44 in the first assignment of eighth grade and a final ratio of 0,53 in the last assignment of tenth grade. Participant 6 experiences a clear high in the second assignment of eighth grade with a ratio of 0,82. After the high participant 6 experienced in the second assignment of eighth grade, the participant has an arguably ebbing from the second assignment in eighth grade to the last assignment of tenth grade. Participant 7 has an initial ratio of 0,14 in the first assignment of eighth grade and ended up with a ratio of 0,42 in the last assignment of tenth grade. Participant 7 has a low ratio throughout the three-year period, but the participant did get high ratios on two separate occasions, where the participant gets a ratio of 0,50 in the first assignment of ninth grade and a ratio of 0,75 in the second assignment of ninth grade. These occurrences highlight the dynamic nature of the accuracy construct and strengthen the hypothesis of a certain nonlinearity in the developmental trajectory of the accuracy construct. Participant 8 experienced a similar developmental trajectory as Participant 6.

Figure 10: Error-Free Clauses to Total Clause Ratio

	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2
Participant 9	0,36	0,21	0,16	0,35	0,53	0,23	0,04	0,52	0,92	0,95
Participant 10	0,60	0,64	0,61	0,76	0,88	0,60	0,65	0,91	0,91	0,81

Figure 10 illustrates the developmental trajectory of participants 9 and 10. Both participants follow similar developmental trajectories where they both experience a noticeable improvement from the first assignment in eighth grade to the last assignment in tenth grade. Where Participant 9 has an initial ratio of 0,36 in eighth grade and ends up with 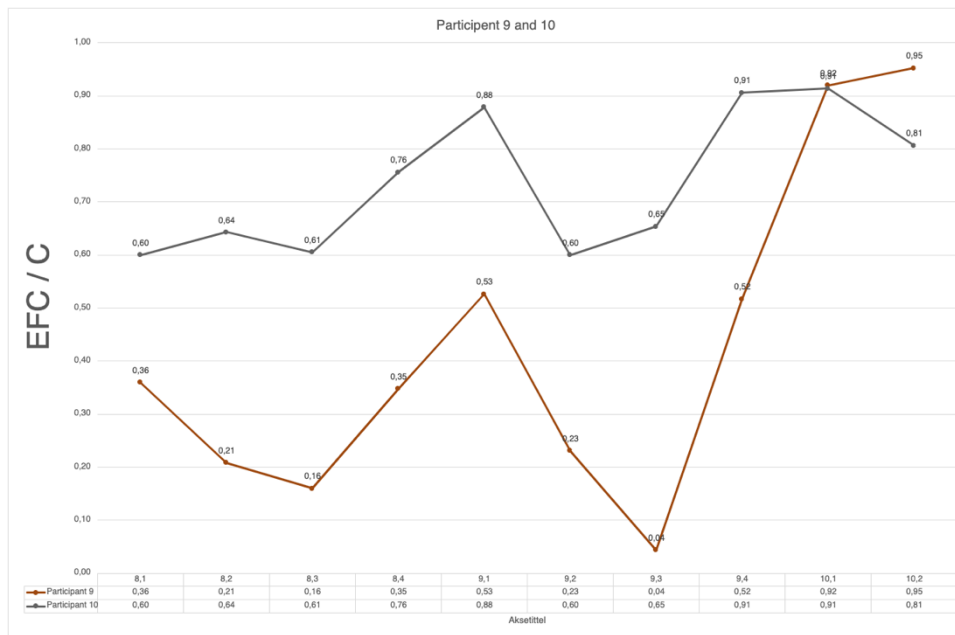a ratio of 0,95 in the last assignment of tenth grade. Participant 9 did, however, experience the lowest ratio of 0,04 in the third assignment of ninth grade which does highlight the dynamicity of the accuracy construct. Participant 10 had an initial ratio of 0,60 in the first assignment of eighth grade and achieves a ratio of 0,81 in the last assignment of tenth grade.

4.2.2 Error type distribution

The distribution of error types provides us with a deeper understanding of the accuracy construct. This error analysis is conducted in light of Louvain error tagging taxonomy (Granger et al., 2022) and the further categorization of the error types in the categories of mechanical error, local error, and global error is done comparatively to Rosmawati (2014). The distribution of error types gives us, as researchers, a deeper insight into the types of errors the participants in this study make while writing. Each error has been meticulously coded and calculated.

Figure 11: Error Type Distribution

Participant 3, 4 and 5

	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2	8,1	8,2	8,3	8,4	9,1	9,2	9,3	9,4	10,1	10,2
Mechanical	0	0	0	1	0	1	1	1	9	2	7	14	10	6	11	10	12	18	6	5	9	5	2	3	8	6	11	13	6	3
Local	4	1	2	2	2	1	3	0	2	2	8	6	10	4	4	6	10	5	9	2	3	16	4	7	5	9	11	0	4	4
Global	1	4	3	3	5	2	6	2	5	1	3	5	8	5	9	2	6	8	5	22	4	5	2	7	3	3	8	4	4	3

Participant 3 · Participant 4 · Participant 5
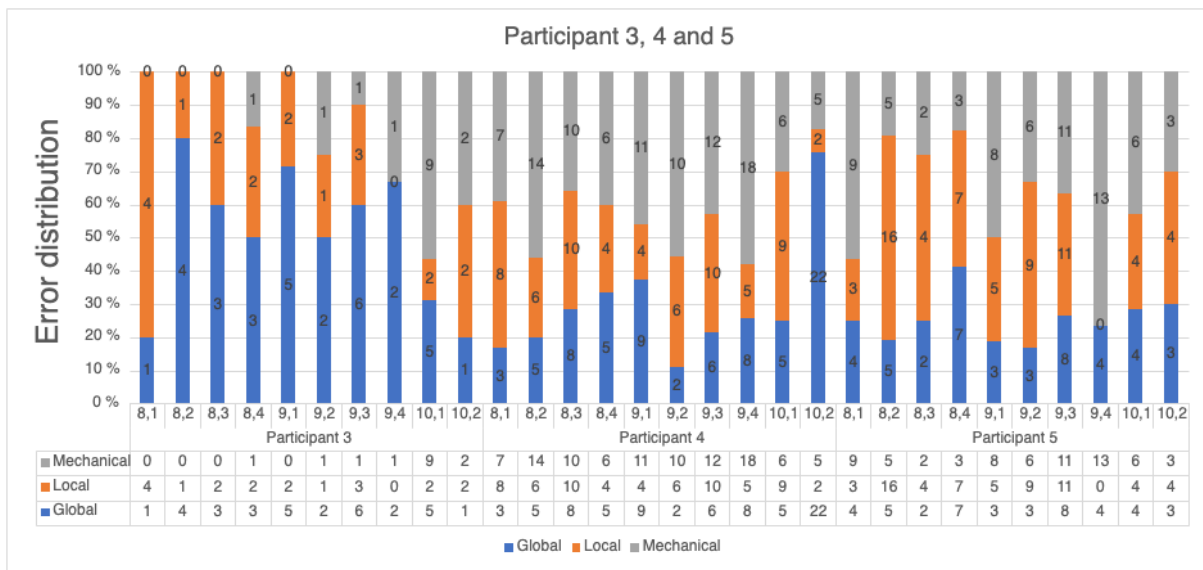
Global ■ Local ■ Mechanical

Figure 11 shows the distribution of error types for participants 3, 4, and 5. The error types are presented as percentages of the total amount of errors in each coded text. The types of errors and the number of errors made vary greatly from assignment to assignment and from participant to participant. Participant 3 has arguably a low number of errors throughout eighth to tenth grade. Where participant 3 only has 5 errors on each assignment in eighth grade. The errors made by Participant 3 consist mainly of local errors and global errors in eighth grade. Participant 3 has a high in errors in the first assignment in tenth grade with a total amount of 16 errors. In this assignment, the majority of errors were mechanical errors. In the last assignment of tenth grade, the participant has five total errors where the participant has two mechanical errors, two local errors, and one global error. participants 4 and 5 have a higher error occurrence than Participant 5. The errors made by participant 4 mainly consist of mechanical and local errors, where the participant experience an increase in both error types throughout a three-year period. However, in the last assignment of tenth grade, participant 4 has five mechanical errors, two local errors, and twenty-two global errors. Participant 5 has arguably a similar trajectory as participant 4 but with a higher occurrence of local errors. Participant 5 experiences an improvement from the first assignment of eighth grade to the last assignment of tenth grade in the category of mechanical errors. Participant 5 has in the first assignment of eighth grade a total amount of 16 errors where the errors are distributed to 9 mechanical errors, 3 local errors, and 4 global errors, and in the last assignment of tenth-grade participant 5 has 10 total errors distributed as 3 mechanical errors, 4 local errors, and 3

global errors. The participant did not show too much improvement in the number of errors in the categories of local error and global error.

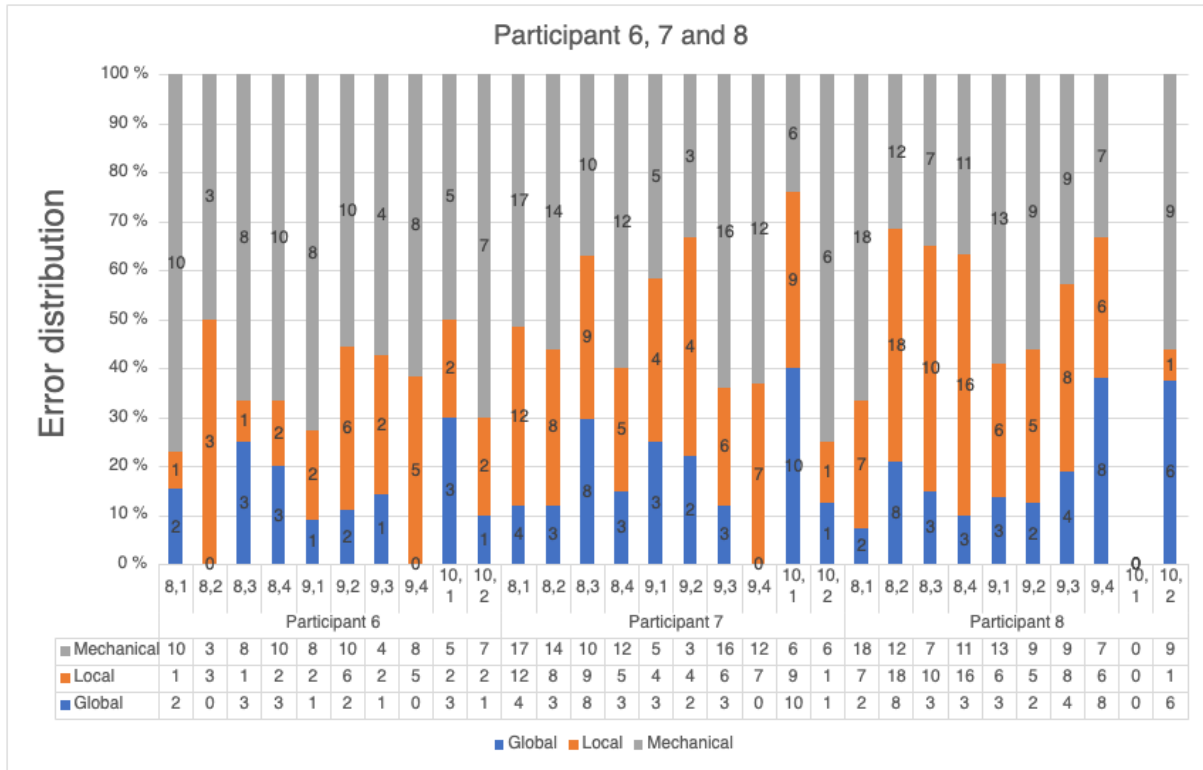*Figure 12: Error Type Distribution*

Figure 12 shows the distribution of the error types for participants 6, 7, and 8. The errors made by Participant 6 mainly consist of mechanical errors, accounting for approximately 5-10 errors on each assignment during the three-year period, with the exceptions of assignments 8,2 (3 mechanical errors) and 9,3 (4 mechanical errors). At first glance, it might seem like the number of total errors remains relatively constant, and the number of errors made in the local and global categories varies more. Local errors vary from 1 local error in assignments 8,1 and 8,3 to 6 local errors in assignments 9,2, and the number of global errors varies from 0 errors in assignments 8,2 and 9,4 to 3 global errors in assignments 8,3, 8,4, and 10,1. It seems like there is some sort of connection between local and global error categories, where a higher number of errors in the local category results in a lower number of errors in the global category, which is also the category with the lowest overall number of errors.

Participant 7 portrays a great degree of variability in the number of errors made and how these errors are distributed. Mechanical errors are the category the participant makes the

most errors within where the participant hovers between 6 and 17 mechanical errors in every assignment except assignment 9,2 which has 3 mechanical errors. Further one could argue that the participant does improve in the accuracy construct. In the first assignment in eighth grade, the participant has a total number of 33 errors (17 mechanical errors, 12 local errors, and 4 global errors), whereas the participant in the last assignment of tenth grade has a total number of 8 errors (6 mechanical errors, 1 local error, and 1 global error). Another interesting point we would like to highlight is the fact that even though it might seem like participant 7 has managed to decrease the number of local and global errors in the last assignment, the participant experienced a high in local and global errors in assignment 10,1, where the participant has 9 local errors and 10 global errors. One could argue that this observation highlights the dynamicity in the developmental trajectory for participant 7.

Throughout the three-year period, it is clear that participant 8 has a high number of total errors in most assignments. In the first assignment of eighth grade the errors consisted mainly of mechanical errors, where the participant has 18 mechanical errors out of a total of 27 errors. The total of 18 mechanical errors was a high in mechanical errors for participant 8, and throughout the three-year period the participant hovers between 7-12 mechanical errors, which is arguably consistent throughout the three-year period. One could say that throughout the three-year period, the participant has a decrease in mechanical errors, but on the other hand the participant has an increase in local errors in assignments such as 8,2, 8,3, and 8,4. After eighth grade, the number of local errors decreased and reached a low in the last assignment of tenth grade with 1 local error. Regarding global errors, the participant has 2 global errors in the first assignment of eighth grade, a ratio that was consistent in a majority of the assignments, with the exception of the last assignment in tenth grade where the participant had 6 global errors and assignment 8,2 and assignment 9,4 where the participant had 8 global errors in both assignments.
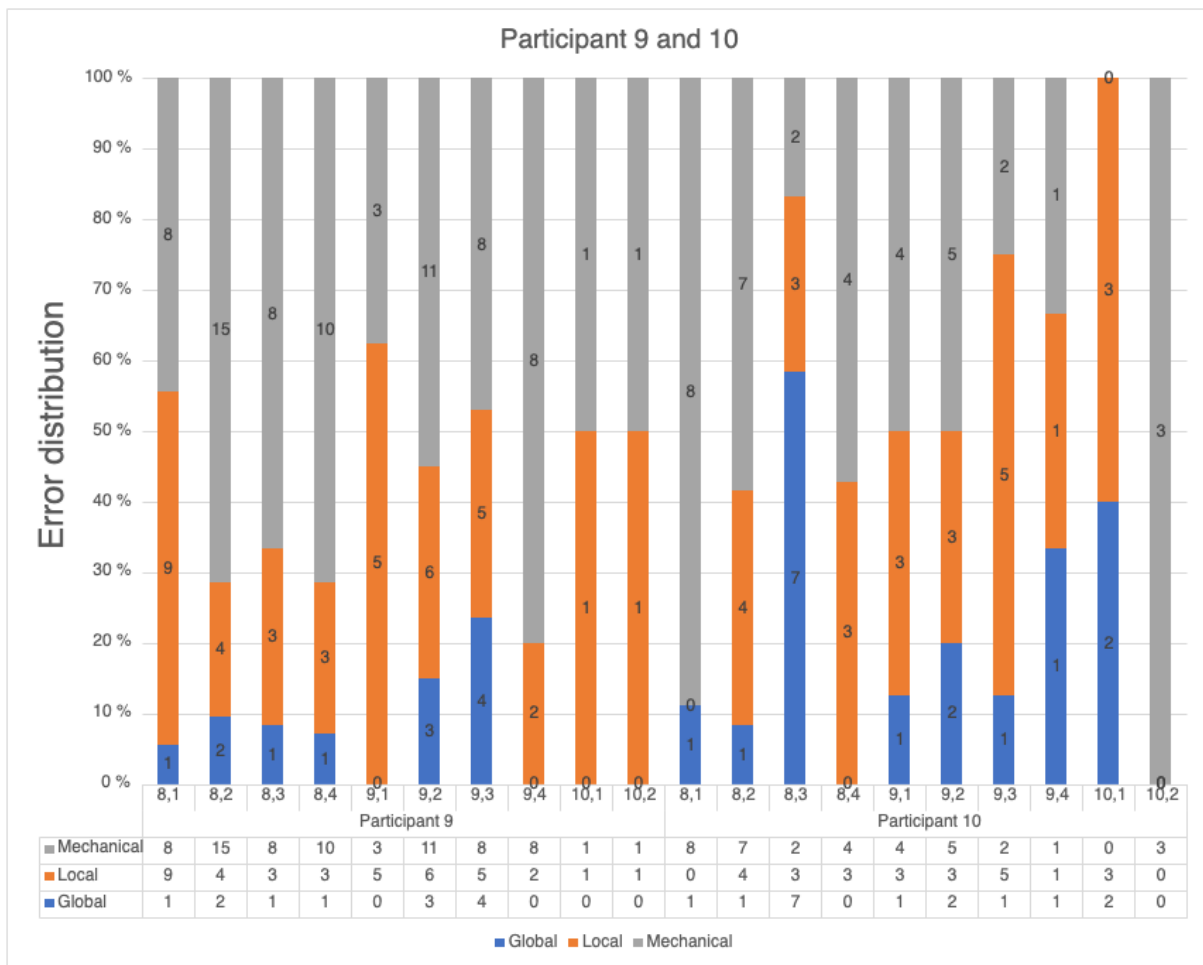
Figure 13: Error Type Distribution

Figure 13 shows the distribution of error types for participants 9 and 10. The errors made by participants 9 and 10 consist mainly of mechanical errors. Participant 9 makes about 8-15 mechanical errors in each assignment, with the exception of assignments 9,1 (3 mechanical errors), 10,1 (1 mechanical error), and 10,2 (1 mechanical errors). Participant 9 does improve its accuracy throughout a three-year period, where participant 9 has a total amount of 18 errors in the first assignment of eighth grade (8 mechanical errors, 9 local errors, and 1 global error) and in the last assignment of tenth grade the participant only has 2 total errors (1 mechanical error and 1 local error). Participant 9 has made improvements within all aspects of the criteria set by Louvain. The errors that participant 10 make consist mainly of mechanical and local errors. Throughout a three-year period, participant 10 arguably experiences an improvement in their accuracy, where participant 10 had 9 total errors in the first assignment of eighth grade (8 mechanical errors and 1 global error), and in the last assignment of tenth-grade participant 10 has only 3 total errors (3 mechanical errors). Participant 10 does not have any local errors in

the first assignment but has 3-5 local errors in all the other assignments with the exception of 9,4 (1 local error) and 10,2 (0 local errors).

## 4.3 Results 3: The Interaction Between Accuracy and Complexity

In this section we are going explore the interaction between the two constructs, namely complexity and accuracy. Firstly, we smoothed the data by using a moving average smoothing method. According to Rosmawati (2014) the data is smoothed to capture general trends that occur within the constructs. This technique was chosen to accommodate the nonlinear nature of the constructs in question (Rosmawati, 2014). This technique is visualised in the graphs on the left side, which is a graphic representation of the relationship between the two variables: accuracy and complexity. Secondly, the graphs on the right side illustrate the dynamics of the temporal interactions between the two variables, thus showcasing the results of a moving correlation analysis. A moving correlation analysis was conducted to examine the correlation between the two constructs complexity and accuracy (Rosmawati, 2014). The results of the moving correlation analysis will give us insight to answer the second research question in this master's thesis: How does the parameters' complexity, accuracy and fluency interact with each other over a three-year observational period? In order to describe the degree of correlation between the construct's accuracy and complexity, we will adhere to the correlation coefficient descriptor guideline table in Table 4.

Table 4: Correlation Coefficient Descriptor

Correlation Coefficient Descriptor (r)	Value (positive)	Value (negative)
Trivial	0.0-0.09	0.0-0.09
Low	0.1-0.29	0.1-0.29
Moderate	0.3-0.49	0.3-0.49
High	0.5-0.69	0.5-0.69
Very high	0.7-0.89	0.7-0.89
Nearly Perfect	0.9-0.99	0.9-0.99
Perfect	1	1

4.3.1 Participant 3

Figure 14: Interaction and Moving Correlation
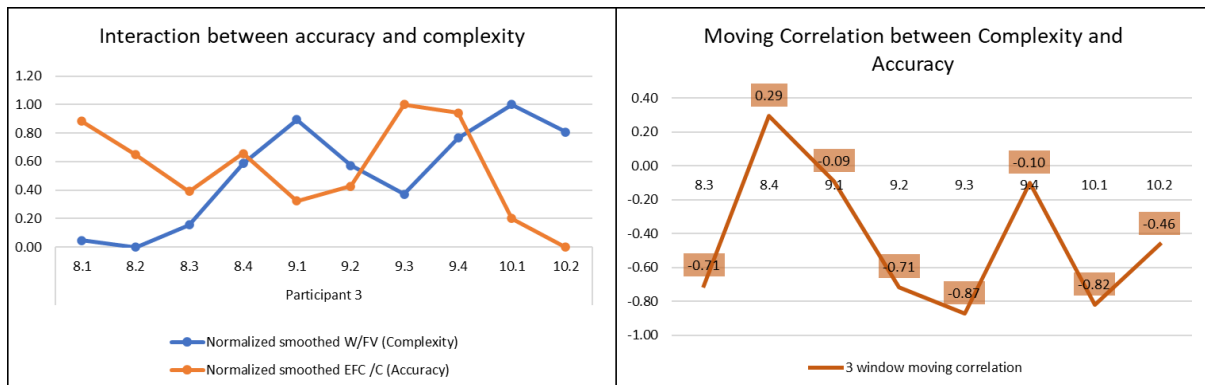
The graph on the left, makes it visible to see how at the start of the three-year period, there is a decline in both indices, but not to the same extent as the accuracy decreases more than complexity. However, after assignment 8.2, there is a shift, as the measurement for accuracy continues to decline, but the measurement for complexity increases. The indices continue to fluctuate, however, from assignment 9.3 the accuracy indices drastically decrease, reaching an all-time low in assignment 10.2, whereas the complexity measure increases overall. Overall, there is a high association between complexity and accuracy.

The graph on the right fluctuates between a strong negative correlation and a low positive correlation. Only in assignment 8.4 was the association positive. A potential trade-off relationship is indicated by these results, however the degree of this trade-off relationship is at to measurement points low (assignment 9.4) or even trivial (assignment 9.1).

4.3.2   Participant 4

Figure 15: Interaction and Moving Correlation
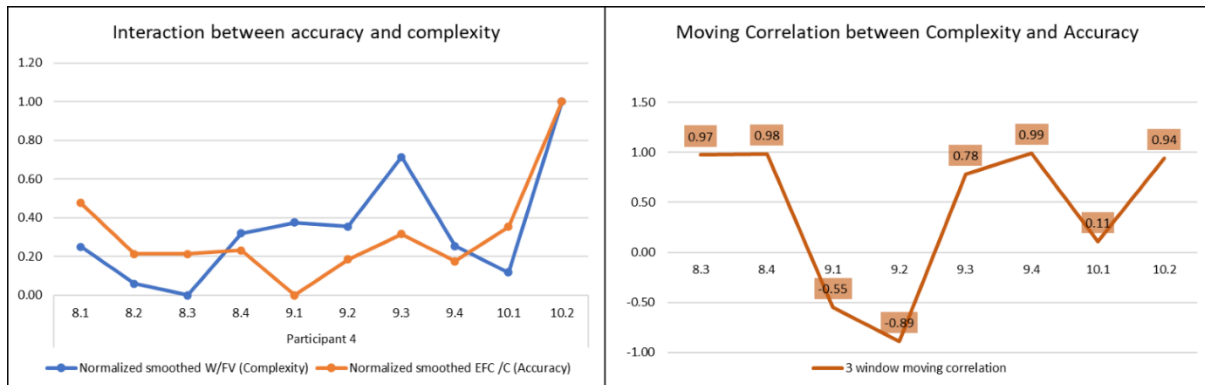
The graph on the left shows that at the start of the three-year period, there is a visible decline in both complexity and accuracy. This decline in fairly discernible from assignment 8.1- 8.3. Further, between 8.3 and 9.1, there is a gradual decline in accuracy, whereas the participant experiences an increase in the complexity construct throughout the same period. Between 9.1 and 9.3 the participant experiences an increase in both complexity and accuracy. Lastly, in the last few assignments the participant experienced a decrease in both indices followed by a high increase in both indices during the last assignment of tenth grade.

Graph on the right fluctuates between a very high, sometimes nearly perfect positive correlation and very high, negative correlation. Halfway through the three-year period, the very high negative moving correlation between accuracy and complexity measured in assignment 9.2, is followed by a noticeable increase in correlation indicative of supportive relationship between construct's, interrupted only by a drop in correlation (assignment 10.1), where there is a low positive correlation.

4.3.3   Participant 5

Figure 16: Interaction and Moving Correlation
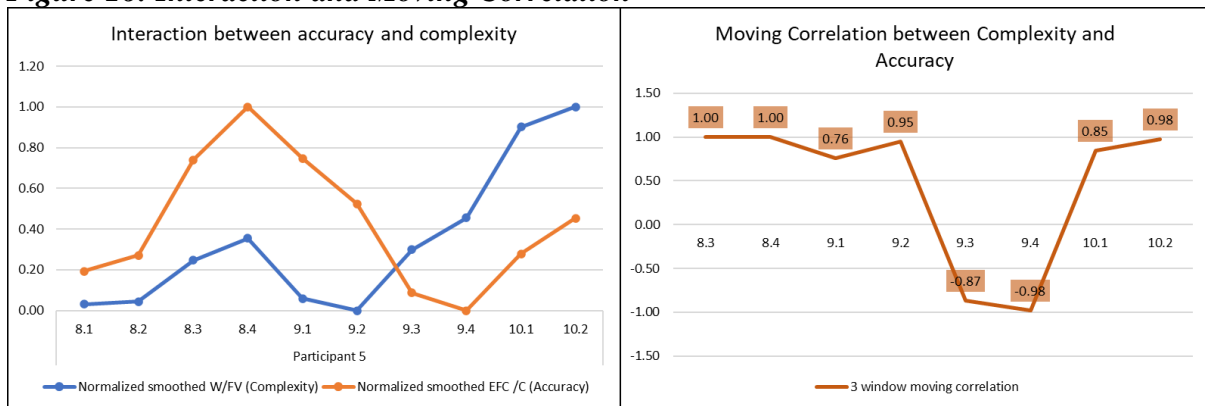
The graph on the left shows that the two indices generally follow the same trajectory. Both indices start off with an increase in both complexity and accuracy between assignment 8.1 to assignment 8.4, where the increase is more apparent in the accuracy construct. Further, between assignment 8.4 to assignment 9.2 both constructs experience a decrease, and the accuracy construct continue to decrease until assignment 9.4. The complexity construct increases drastically between assignment 9.2 to assignment 10.2, whereas the accuracy construct increases at a slower rate between assignment 9.4 and 10.2.

The results of the 3-window moving correlation analysis portrays an overall very high correlation between the accuracy and complexity constructs, fluctuating between very high and perfect positive correlation, with only two consecutive data points towards the end of ninth grade which are significantly lower, thus portraying a very high to nearly perfect negative correlation between accuracy and complexity. This shift is indicative of a sudden competition between the constructs. The drop is then followed by a very high to nearly perfect positive correlation again.

4.3.4 Participant 6

Figure 17: Interaction and Moving Correlation
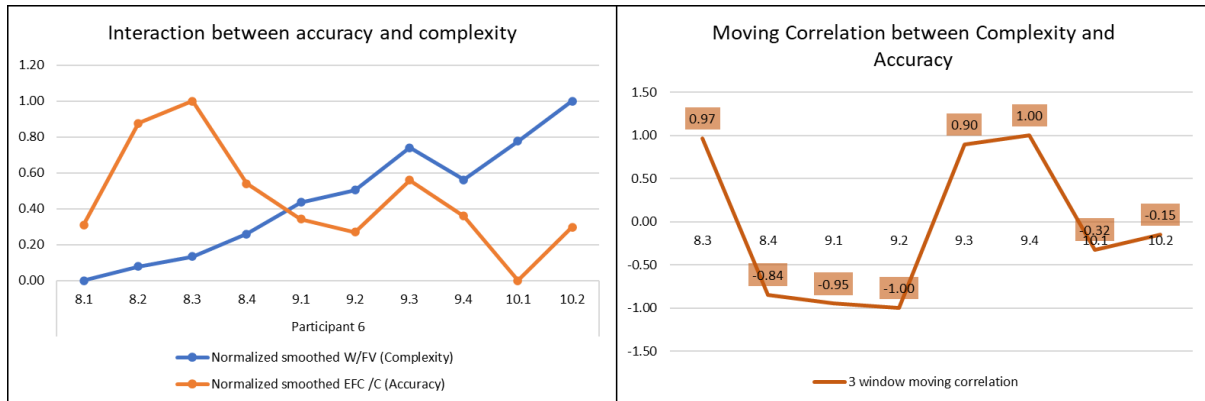
The graph on the left show that both indices experience an increase between assignment 8.1 and assignment 8.3. However, after assignment 8.3 the participant undergo a decrease in accuracy, whereas the complexity construct continues to experience an increase. On the other hand, the accuracy construct experiences a continuous decline between assignment 8.3 and assignment 10.1, with the exception of assignment 9.3 where the participant had a small increase in accuracy.

When examining the moving correlation analysis, it is clear that the participant initially experienced a strong positive relationship with a score of 0.97 in assignment 8.3. Further, the participant experience strong negative association in assignments 8.4, 9.1, and 9.2 which arguably suggests that the constructs have a trade-off relationship. Thereafter, in assignments 9.3 and 9.4, the participant experiences a strong positive relationship with a score of 0,90 and 1.00. In the last two assignments the participant has an arguably low negative association between the construct complexity and accuracy.

4.3.5 Participant 7

Figure 18: Interaction and Moving Correlation
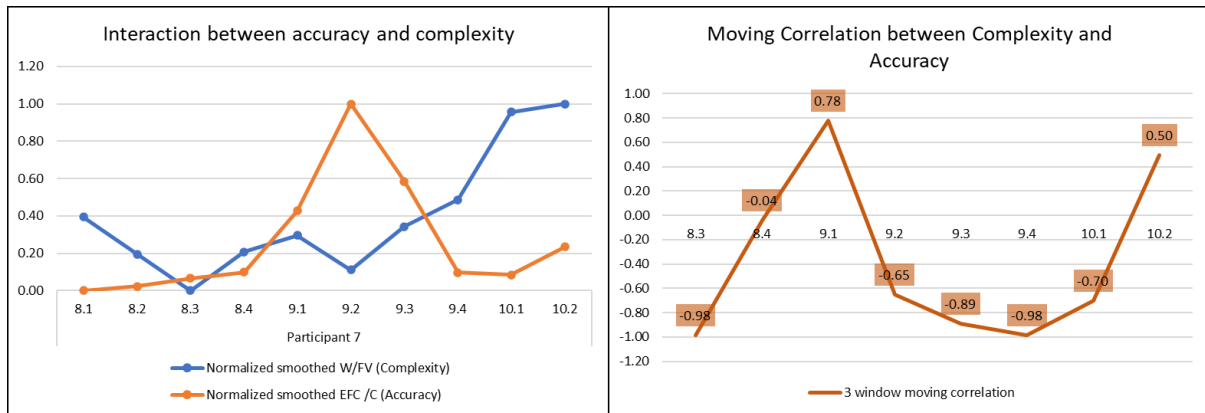
The graph on the left shows that both indices movie in opposite direction for the three first assignments. This means, that one could argue that when accuracy increases the complexity decrease. However, the participant experiences a slight increase in both complexity and accuracy after assignment 8.3. Throughout the three-year period it is clear that there is fluctuating relationship continues as the participant experiences a dramatic decrease in the accuracy construct after assignment 9.2, which leads to a striking increase within the complexity during the same period. During the last assignment the participant experience an increase in both indices.

By examining moving correlation analysis, it is clear that there is a fluctuation between a strong negative and positive correlation throughout the three-year period for participant 7. The participant had an initial strong negative correlation of -0.98 in assignment 8.3 which is arguably a nearly perfect association between the two indices. In assignment 8.4 the participant had a trivial negative assassination which turned into a very high strong association in assignment 9.1 where the participant had a correlation of 0.78. In assignment 9.2 to assignment 10.1 the participant had a very strong negative association between the two indices, where assignment 9.4 had a nearly perfect negative correlation of -0.98. In the last assignment of tenth grade the participant had a high correlation of 0.50. This participant also displays a possible trade-off relationship between the indices in many of the assignments analysed in thesis, as a high negative association means that the indices develop in opposite direction.

4.3.6   Participant 8

Figure 19: Interaction and Moving Correlation
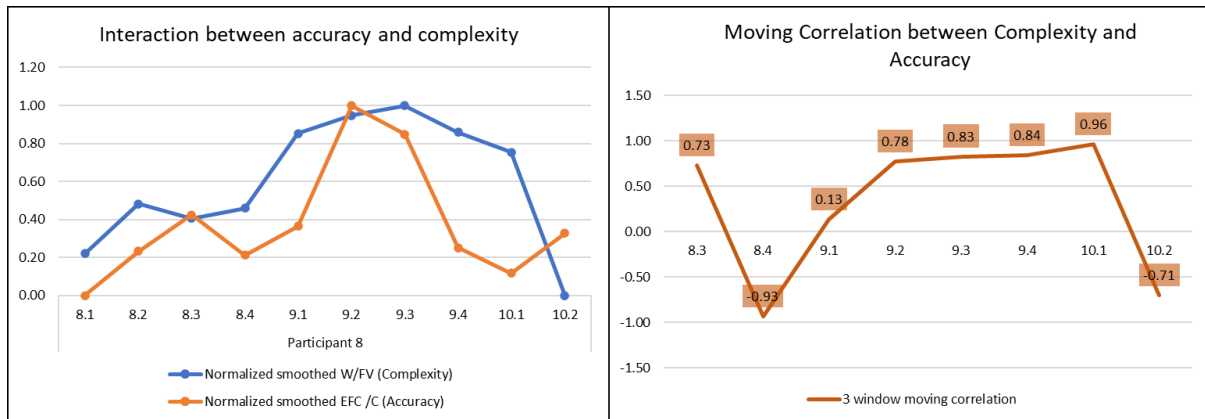
The graph on the left show that the participant has an increase in both complexity and accuracy in both assignment 8.1 and assignment 8.2. This developmental trajectory arguably continues until assignment 9.2, with the exception of assignment 8.4 where the participant undergo a decline in accuracy. After assignment 9.2 the participant witnesses a decline in both complexity and accuracy. The participant experiences a small increase in accuracy in the last assignment of tenth grade.

The moving correlation analysis reveals that us that there are strong positive association between the construct's complexity and accuracy. In assignment 8.3 the participant has a very high correlation of 0.73. However, in assignment 8.4 the participant has a nearly perfect negative association of -0.93. Further, the participant experiences a low positive correlation in assignment 9.1 but in assignments, 9.2, 9.3, 9.4, and 10.1 the participant experiences a very high positive correlation in both complexity and accuracy.

4.3.7   Participant 9

Figure 20: Interaction and Moving Correlation
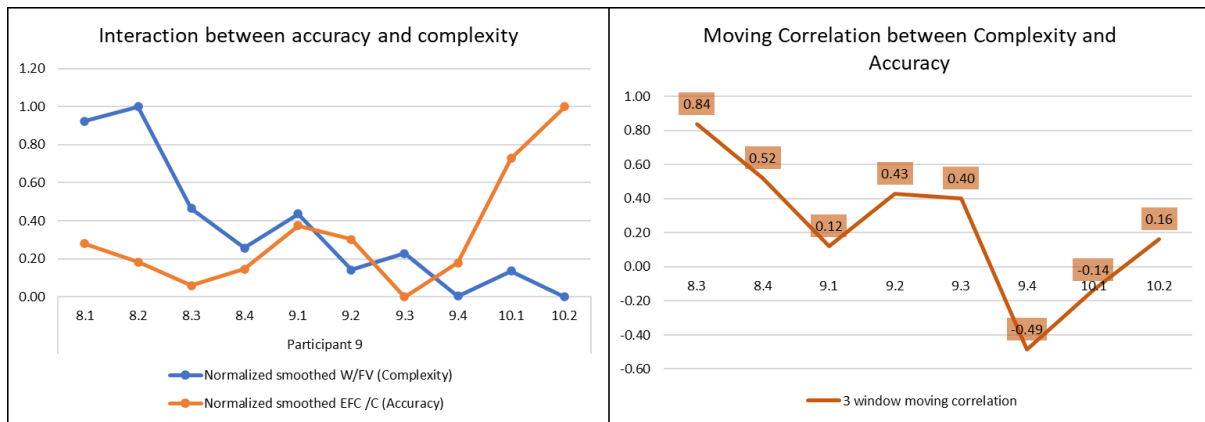
The graph on the left shows that the participant has a gradual decline in both complexity and accuracy during assignments 8.1, 8.2, and 8.3. From assignment 8.4 to assignment 9.4 the interaction between accuracy and complexity ebbs and flows, where the participant experiences an initial increase in both constructs between assignments 8.4 and 9.1, which again leads to a decline between assignments 9.1 and 9.2 in both complexity and accuracy. Further, the accuracy construct undergo a dip between assignments 9.2 and 9.3, whereas the complexity construct experiences an increase between assignments 9.2 and 9.3. Lastly, between assignments 9.3 and 10.2 it is clear that the participant experiences an overall decline in the complexity construct and an overall increase in accuracy the accuracy construct.

In assignment 8.3 there is a very high positive correlation between the construct's complexity and accuracy with a score of 0.84. Further, it is clear that there is a positive correlation between the constructs in assignments 8.4 to assignment 9.3. However, the positive correlation varies greatly where assignment 9.1 only have a low positive correlation between the constructs whereas assignment 8.4 has a stronger association between the construct with a score which can be considered a high positive correlation. In assignment 9.4 the participant has a moderate negative correlation and in assignment 10.1 the participant has a low negative correlation. In the last assignment 10.2 the participant has a low positive correlation.

4.3.8 Participant 10

Figure 21: Interaction and Moving Correlation
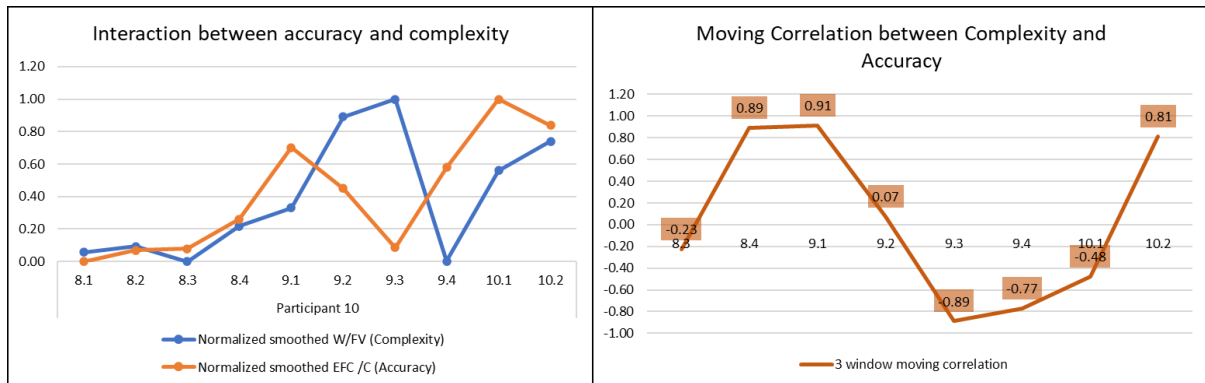
By examining the graph on the left it is clear that the indices complexity and accuracy experiences what one could argue is a high degree of dynamicity. Both the accuracy construct and the complexity construct have a small increase from assignment 8.1 to assignment 8.4, where the participant does experience some minor dips in the complexity construct in the same time period. However, between assignments 8.4 to assignment 10.2 the participant has a developmental trajectory that is arguably chaotic. The complexity construct experiences a consistent increase between assignment 8.3 and assignment 9.3, whereas the accuracy construct has an initial increase between assignment 8.3 to assignment 9.1, but the participant has a gradual decrease between assignment 9.1 to assignment 9.3. After assignment 9.3 the participant experiences a decline in complexity, whereas the participant experiences an increase in accuracy between assignment 9.3 to assignment 10.1. Lastly, the participant experienced a decrease in accuracy between assignment 10.1 to assignment 10.2 and an increase in complexity between assignment 10.1 to assignment 10.2, which arguably suggest a possible trade-off relationship holds between the constructs.

When examining the moving correlation analysis, it is clear that the association between the constructs complexity and accuracy fluctuates greatly during the three-year period. Initially, the participant has a low negative correlation between the two constructs with a score of -0.23. However, in assignments 8.4 and 9.1 participant has an arguably nearly perfect positive correlation between the two constructs. Further, the participant experience a trivial positive correlation in assignment 9.2, which leads to a high negative correlation in assignments 9.3, 9.4, and 10.1. Lastly, the participant has a very high positive correlation in assignment 10.2.

5   Discussion

The aim of this research project was to investigate the development of complexity and accuracy constructs in the English writing of Norwegian ESL learners attending lower-secondary school, during a three-year period. This chapter aims to answer the following research questions:

RQ1: How does Norwegian lower-secondary learners' written work develop in terms of complexity and accuracy over a three-year period?

RQ2: How does the measures of complexity and accuracy constructs interact with each other over a three-year observational period?

The findings presented in the result chapter (chapter 4) will be discussed in relation to the theory presented in the Literature Review (chapter 2). This chapter is structured according to research questions. Therefore, we will first attempt to answer the first research question by examining the constructs individually. This is due to the fact that the data is descriptive and was plotted into graphs and bars to visualize the dynamicity along the developmental continuum (Rosmawati, 2014). Secondly, we will attempt to answer the second research question as the correlation analysis was conducted to explore the association between the two constructs' complexity and accuracy (Rosmawati, 2014). Further, we will make some general claims about certain aspects of the study conducted. Examples of these claims are the directionality of the L2 development of the construct's complexity and accuracy. Further, we will discuss pedagogical implications related to this study and provide recommendation of further research within the field of L2 studies.

5.1   *Summary of the Study and Key Results*

The overall findings of this master thesis, lend support to the pivotal notion of CDST because the participants in this study did experience a development trajectory that displayed non-linear behaviour and high degree of variability, thus demonstrating the main characteristics of a complex dynamic system. The results indicate that both the constructs, complexity and accuracy, individually demonstrated dynamicity along their developmental paths, (different

patterns). These are findings that are consistent with those of Rosmawati (2014), Larsen-Freeman (2007), and Jiang (2013), where all of these studies support the notion that there is a notable variability in the developmental trajectory of L2 development. According to Larsen-Freeman (2006) L2 development «…is not discrete and stage-like but more like the waxing and waning of patterns (...) certain aspects of the behaviour are progressive, other regressive; that change can be gradual, and it can be sudden» (Larsen-Freeman, 2006, p. 590). The study also shows that there is a great discrepancy between the participants in the study, which is to be expected as this study is mainly interested in examining the developmental trajectory of the learners individually. However, general trends do occur which can be examined.

5.2   Discussion of the Findings

The following section is comprised of four sub-sections, where the results of the descriptive analysis of the complexity construct (10.2.1), and the accuracy construct (10.2.2) are discussed. The discussion of the findings is the followed by a discussion of the directionality of the development of both the accuracy and complexity in L2 (10.2.3). The last sub-section discussed the findings related to the interaction of the constructs (10.2.4). The discussion chapter concludes by outlining the limitations of the findings (10.3).

5.2.1   Developmental Continuum of the Complexity Construct.

The descriptive analysis of complexity as a construct in measuring English writing ability of the EFL learners, was conducted by a W/FV ratio and sentence type analysis. Firstly, it is apparent that the participant in this study generally demonstrates a high level of complexity. This is especially evident in the sentence type analysis where most participants utilize complex sentence types such as compound-complex sentences and there is an arguably low presence of simple sentences. There are certain exemptions such as participant 3 assignment 9.2, Participant 5 assignment 8.3, and participant 10 assignment 8.1 which had between 9 and 11 simple sentences each. However, generally, for all the participants, only 1-3 simple sentences were present in the assignments containing simple sentences. Participants 4, 6,7, and 9, had the lowest presence of simple sentences, with more than 50 % of the assignments containing zero simple sentences. However, this can be somewhat misleading, as the number of sentences written per assignment varies greatly both intra-individually and inter-individually, which could potentially explain these differences. The W/FV ratio analysis attempt to capture the

overall grammatical complexity of each participant. According to Housen et al. (2012), grammatical complexity is highly multidimensional in nature and ideally requires several measures to adequately gauge the construct. In this research project, we only employ the W/FV ratio, however, according to Rosmawati (2014), this measure does, to some extent, represent a rudimentary picture of the overall grammatical complexity of each participant in this study. According to our results, most of the participants experience an increase in overall grammatical complexity throughout the three-year period. These findings are in line with those of Rosmawati (2014), where Rosmawati argues that her finding reflected the behaviour of a dynamic system. Because even though most of the participants experienced an increase in overall grammatical complexity throughout the three-year period all participants experienced a developmental trajectory that clearly is in line with a feature of a dynamic system. These are results that are present in similar studies such as Rosmawati (2014), Verspoor et al. (2012), and Thewissen (2013). However, this research yielded some interesting results regarding W/FV ratio. First, Participant 9, generally has a complex sentence type distribution, with very low presence of simple sentences and a high amount of both compound and compound-complex sentences, and a high total sentence count. However, investigating the W/FV ratio, it becomes evident that the participant has had a conspicuous decrease in overall complexity during the three-year period. In the first two assignments of 8th grade, participant 9's W/FV ratio ranged between 13 and 13,69, which is patently high. At several measurement points thereafter, the participant's ratio is measured below 10, and in the last assignments is as low as 5,78, which is an overall low in this study when considering all participants. Participant 10 also experiences an overall decrease in complexity, however, the pattern of the W/FV ratio graph in Figure 3 is very different from that of Participant 9. Participant 10 initially had a quite low level of complexity, with a ratio varying between 8-10. In the second half of the three-year period, however, the ratio is more chaotic, which arguably is indicative of the development of L2 proficiency (Housen et al., 2012). The measured W/FV ratio reaches its highest point in assignment 9.2, before dropping down to a level lower than the initial one. In the last two assignments, participant 10 once again experiences a conspicuous increase followed by an equally striking decrease, which is measured at a comparable level to the first assignment. It is difficult to determine whether or not these results are indicative of a lasting negative development. As stated by Larsen-Freeman (2006), these anomalies might be due to an array of factors other than learning, including both external social factors and internal restructuring of the linguistic system.

5.2.2 *Nature of Development of Accuracy Construct*

The nature of development of the accuracy construct was measured by using an error tagging analysis and an EFC/C ratio analysis. Firstly, it is apparent that within the accuracy construct, there is a great deal of inter and intra-variability in both the error type analysis and the EFC/C ratio analysis. In this first section we will discuss the error tagging analysis conducted using The Louvain error tagging manual version 2.0 (Granger et al., 2022) However, if we are looking at "trends" among the learners, it is possible to group the participants by the error category which was dominantly present. Participants 6 – 10 mainly conducted mechanical errors, where participants 9 and 10 objectively had a low number of total errors, whereas participants 3, 4, and 5 made more local and global errors than the other participant.

At first glance, the error type that conceivably most participants make is mechanical errors. However, there is a great disparity between the participant when looking at total errors made in each text. Participants 9 and 10 both arguably make few errors in the categories of local and global errors, and a clear majority of the errors made by these two participants are mechanical errors. Participant 3 on the other hand makes few mechanical errors but has to a greater extent more global errors. The global error category is made up of the error tags grammatical errors and style errors whereas mechanical errors are made up of the error tags formal errors and punctuation errors. These error categories are generally very different types of error and there is a great discrepancy between the errors made by the participants. Global errors are errors that make up entire clauses and sentences and include grammar mistakes and incomplete sentences (Rosmawati, 2014). Considering the Louvain error tagging manual (Granger et al., 2022), one could argue that certain errors are more problematic than others. For instance, the global category, which includes the error tags style and grammatical, might suggest errors that are tied to the learner's overall understanding of the English language system, whereas errors within the mechanical category include categories such as formal and punctuation errors that can be affected by external factors such as the computer where the errors to a greater extent are less erroneous when considering learners' knowledge and competence with the English language as a system. In the study conducted by Rosmawati (2014), she highlights the fact that it is surprising that an advanced learner such as Machiko had mechanical errors in 9 out of 10 texts. This presumably implies that mechanical errors, according to Rosmawati (2014), are more erroneous than global errors for advanced learners. Our participants are not considered advanced learners and due to this fact, we would expect the participants to consistently make mechanical errors in most of their texts. The present findings

in our master's thesis seem to be consistent with argument Rosmawati (2014) makes, and most of the participants do have a majority of their errors as mechanical errors. However, participant 3 (Figure 11) had zero mechanical errors in assignments 8.1, 8.2, and 8.3, and further consistently has a low number of mechanical errors in the other assignments provided by Participant 3. The errors made by Participant 3 were mainly global errors, which we argue might be more erroneous than mechanical errors. Therefore, one could argue that the results of the error tagging analysis are in line with the findings of other researchers such as Rosmawati (2014).

An inspection of the EFC/C results, reveals that despite a tremendous amount of fluctuation, all the participants demonstrated an overall increase in accuracy. These findings seem to be consistent with the findings reported by Thewissen (2013) and Verspoor et al. (2012), where the accuracy measures over time exhibited an overall increase, although intra-personally there was a high degree of variability and fluctuation. Thewissen (2013) has contended that a crucial component of the development of L2 writing is progress and stabilization, which implies, despite non-linearity, there is no dramatic decline in the measures over time. However, in our results, there is no evident stabilization as such.

5.2.3   *Directionality of the Development of L2 Accuracy and Complexity.*

The results of our study do not suggest that L2 language development of the participants follows a single direction, a finding that agrees with the finding of Verspoor et al. (2008). Learners may experience progress and regression, with L2 development ebbing and flowing over time. Consequently, simple general trends are insufficient in describing this dynamic process. Instead, each measure has its own idiosyncratic pattern of development, as noted by several studies (Jiang, 2013; Polat & Kim, 2013; Thewissen, 2013; Vyatkina, 2012, 2013). Many of these studies are in line with the 2006 study conducted by Larsen-Freeman (2006), which argues that individual learners experience individual and unique L2 developmental trajectories. In our study, some of the participants experienced, for example, an increase in the accuracy in assignment 8.4, whereas some participants experienced a decrease in accuracy in the same assignment. The participant's intra-individual trajectories demonstrated in this study further align with Larsen-Freeman's (2006) findings, which suggest that characterizing L2 development on a group level using general trends is inadequate and impractical. This is because it appears to fail to account for the non-linear nature of individual measures' unique

developmental trajectory. In fact, the micro-level idiosyncrasy is reflective of the idiosyncrasy present at the macro level, where each learner's development is unique (de Bot, 2008; Kim & Sankey, 2009; Verspoor et al., 2008). Rosmawati (2014), while also supporting Larsen-Freeman's (2006) finding, asserts this further by stating that «no two learners experience the same development, and there is, therefore, no such thing as a typical/average learner" (Rosmawati, 2014, p. 92). Thus, the findings of this study support the DST proposition of L2 developmental dynamics.

5.2.4 *The Interaction between the Complexity and Accuracy Constructs*

After conducting the descriptive analysis, we explored the interaction between the complexity and accuracy constructs by conducting a moving window correlation analysis, which allowed for the exploration of the interaction and relationship between the two constructs. The results of the moving window correlation analysis are indicative of a dynamic and non-linear relationship between the language (sub-)systems of accuracy and complexity, as evidenced by the intra-individual patterns of fluctuations observed over time. The observable dynamicity and non-linearity in the interaction between the constructs further confirm the intraindividual developmental trajectories, a finding that seems to be consistent with the research conducted by Larsen-Freeman (2006) and Rosmawati (2014).

The interaction between the two constructs, viz., complexity and accuracy develop differently from participant to participant. A majority of the assignments for participants 4, 5, 8, and 9 show a positive interaction between the constructs, whereas participants 3, 6, 7 and 10 have more assignments that demonstrate a negative interaction between the constructs. Another aspect that varies greatly from participant to participant is how strong or weak the correlation between complexity and accuracy are. For instance, participant 5 exhibited data that showed a nearly perfect positive correlation in most assignments investigated in this study. However, few assignments where participant 5 had a negative association between the constructs could also be categorized as a nearly perfect negative correlation between the two constructs complexity and accuracy. Participant 6 is another participant that experienced similar readings. Participant 6 exhibited a positive association between complexity and accuracy, where the participant had a nearly perfect correlation between the two constructs, and when the participant had a negative association in complexity and accuracy the participant had a nearly perfect negative correlation.

The shift between strong positive and negative associations between the two constructs complexity and accuracy is arguably an indication of a need for longitudinal studies by drawing upon the CAF triad to examine the developmental trajectory of L2 learners over time. This is due to the fact that all participants in our study experienced a shift between positive and negative correlation. Many of the participants, for example participants 3 and 4, experienced this shift multiple times during the three-year period. The shift the participants experienced indicates clear periods where the development of each construct supported the development of the other construct. On the other hand, some participants experienced strong positive associations and clear periods where the constructs complexity and accuracy undoubtedly have a competitive grower relationship. When examining the smoothed data on the left side in Figures 14, 16, and 18 it is clear that many participants experience periods where for example the accuracy constructs undergo an increase and the complexity constructs undergo a decrease, and vice versa. This means that one could argue that which constructs receives the attentive resources from the learner is highly dependent on the type of assignment the participant is assigned. A major weakness in this study is the fact that the assignments used in this study varies in genre and length, factors that would undoubtedly affect the performance of the learner. Further, we lack data on the circumstances these assignments where written in. Housen et al. (2012) argue that there are many factors that can affect the manifestation of the constructs within the CAF triad. Language task variables are arguably one of the most important factors that can affect the manifestation of CAF constructs because task format and complexity of the task in question will affect the manifestation of CAF. However, these claims are not empirically validated (Housen et al., 2012). The shifts the participants experiences are in accordance with the theory of CDST and mirrors the results from previous studies conducted to investigate the interaction between language sub-systems, such as Polat and Kim (2013) and Rosmawati (2014).

5.3   Limitations of the Findings

The results of this study are restricted in their generalizability because, like all case studies, they reflect the growth of the individual participants. The results are therefore not applicable to other learners; however, they are generalizable in a theoretical way. As stated by Yin (2018); the goal "will be to expand and generalize theories (analytic generalizations) and not to extrapolate probabilities (statistical generalizations)"(Yin, 2018, p. 58). The study is restricted to learning of English as L2 by learners whose L1 is Norwegian, which are Indo-

European languages with Latin-based scripts. Future research might involve learners with an L2 other than English. Another possibility for future research, is investigating learners with other L1 backgrounds, which possibly would entail cross-linguistic differences including grammatical forms, written scripts, and phonetic structures, and may result in disparate learning trajectories. Cross-cultural differences, such as those related to gender roles and politeness, may also potentially influence their L2 development of writing skills. These are differences that should be addressed in future CDST studies. The evidence presented in this master thesis, where eight participants' L2 development of writing skills was found to be essentially a non-linear, interconnected, and dynamic system in nature, is, however generalizable in that it validates the theoretical framework that is invoked in this study, namely, CDST.

Unlike conventional experimental research, longitudinal research calls for ongoing data gathering that may be hampered by personal or academically related circumstances of both subject and participant researcher(s). The second restriction thus has to do with task type and scheduling. As this research project relied on school to furnish archived learners writing assignments that they had access to, we had no influence on either the task type nor how the tasks were dispersed throughout the three-year period. We, therefore, do not know if there were significant gaps in the data collection. However, longitudinal case studies such as the one conducted here, according to Cohen et al. (2018) require flexibility in both design and data collection. The upside to this type of data collection is that the data set arguably represents an authentic representation of the writing conducted by Norwegian lower secondary learners through their three years of study in lower secondary school.

One of the main limitations of this study is the somewhat ambiguous nature of the constructs in the CAF triad. As touched upon in the literature review chapter, there is a plethora of factors that might affect the CAF triad as a tool for measuring constructs such as complexity and accuracy. Housen et al. (2012) identify a range of external factors that affect the manifestation of the constructs within the CAF triad. Such external factors include learner variables where cognitive abilities and motivation undoubtedly will affect the manifestation of the construct's complexity and accuracy (Housen et al., 2012). Motivation is a variable that research (Meld. St. 22, 2010-2011), has found to decline significantly towards the conclusion of the tenth grade in the Norwegian school context. This could be part of the explanation of why the two learners experienced an overall decline in complexity in their written assignments that we have scrutinized in this study. However, this is something we do not know and cannot claim as a fact nor argue convincingly. In this study, it is impossible to use metrics to account

for external social variables such as home life, motivation, and social condition that undoubtedly affect the complexity and accuracy constructs in a practical setting. One could argue that these factors are a part of the participant's complex dynamic system. However, obviously an external factor that affects manifestation of CAF the most is the language task variables (Housen et al., 2012). As the constructs within the CAF triad does compete for cognitive resources the type of task given will most likely affect how CAF will unfold during a task. An example of this is the condition a task is written in. Housen et al. (2012) affirm that teachers can to some extent manipulate the complexity of tasks given in class by directing the usage of cognitive resources. Some examples of how teachers can direct the usage of cognitive resources are the preliminary criteria of tasks given, time allocated to task completion, and if participants got feedback on their texts before they submitted the final result. These are all factors that definitely can affect how complexity and accuracy manifest in each participant of the study, and these are factors we are not able to account for in this particular study. This was also one of the of the main reasons for excluding the fluency construct in this particular study, as we were not present in the production of the assignments, and we also lack the information of an in-depth criteria of the task information in each assignment. Within the field there are several practices in how researchers utilized the constructs within the CAF triad. Spoelman and Verspoor (2010) and Rosmawati (2014), for example investigated only the complexity and accuracy constructs, whereas Thewissen (2013) focused exclusively on the accuracy construct.

Further, we also must acknowledge that the texts produced by the participants are in various genres. More specifically, the type of texts included in this study is a combination of fiction, non-fiction, and various types of argumentative texts. The alternative would have been a repetitive task design, similar to the design of Larsen-Freeman study from 2006, which is one effective strategy to cope with the fact that "even subtle differences in a task can affect performance profoundly" (Thelen & Corbetta, 2002, p. 61). However, complexity has been proven to improve with task-repetition (Bygate, 2001), thus task-repetition also has profound limitations, thus making it a less viable option to being with.

Lastly, as touched upon and acknowledged in the methodology chapter, the lack of external coders weakens the reliability of the data. The Louvain error tagging system is made up of certain categories that evidently are meant to be coded in an objective manner. One could argue that a singular coder, or in this case two coders working together, will ostensibly develop their understanding of the analysis employed in this study throughout the process itself. We have tried to combat this drawback by being fully aware of this weakness and going back and

recoding certain sections in light of our developed understanding of the analyses used in this master's thesis.

6   Pedagogical Implications

In this longitudinal study which measures writing skills of eight L2 English learners, there are several possible pedagogical implications that can be considered. The findings of this master's thesis could possibly inform and improve teaching practices in the Norwegian context. Firstly, it indicates the need for a re-evaluation of what we have dubbed «the linear development bias», which undeniably is present in the national curriculum called LK20.

As explained in detail in the discussion chapter, the findings of our study show that L2 development not only is a non-linear, time-locked, and unpredictable process but also a highly individual process with both intra- and inter-individual differences. Each learner follows a unique trajectory during their L2 development. Variability is found to be characteristic of L2 development, and occasional and significant peaks are part and parcel of this norm (Verspoor et al., 2008). This implies that deviations from the expected linear development trajectory of writing skills, should not be considered as a failure nor a sign of regression in terms of learning; rather it should be recognized as an indication that the learner is developing their writing skills. Exploration of new forms and meanings is thus necessary before the learner is able to become accurate, and the evidence supporting that the amount of variability correlates positively with the amount of learning that learners experience, is increasing (Verspoor et al., 2008). Variability in the learners' language output should therefore be acknowledged by teachers as signs of development. Therefore, it is crucial to provide learners with opportunities to experiment and take risks with language and to then reward such experimentation and risk-taking, as this has long-term benefits for the learners' L2 development. The notion of experimentation and risk-taking ties directly into the "relevance and central values" section in the national English curriculum, where «an exploratory approach to language» (Ministry of Education and Research, 2019, p. 2) is part of the overarching goal of the learner.

This new perspective on L2 development and English as L2 in particular could also have implications for L2 English writing assessment and the ways in which teachers provide feedback in the Norwegian context. Giving positive feedback to learner's «failures» in form of risk-taking and subsequent, possibly inaccurate language output, is challenging on behalf of the teacher. For the last 50 years, providing written corrective feedback on the learners linguistic errors in their L2 written work, has been central (Bitchener, 2021). The underlying motivation for teachers when providing feedback is to facilitate learning, however as we have

pointed out, the error itself might be an indicator of L2 development already taking place. Research on written corrective feedback, has been inconclusive as to what method (targeted, comprehensive, focused, unfocused, and metalinguistic) best facilitates learning (Bitchener, 2021), and one could thus speculate if the answer lies in not *how* the feedback is given, but rather in *what* is being given feedback on. Thus, the findings of our research could presumably help English teachers, at least in the Norwegian educational context, gain insights as to what they should provide corrective feedback on and why.

The Norwegian national English curriculum states that «The development of writing proficiency in English progresses from learning single words and phrases to creating different types of coherent texts that present viewpoints and knowledge» (Ministry of Education and Research, 2019, p. 4). Writing development is juxtaposed with the word "progresses", in the national curricula sketching of how the basic skills of reading, writing, oral and digital skills emerge in the English subject after tenth grade (Ministry of Education and Research, 2019). The term "progresses" evokes strong connotations of improvement and enhancement, and thus a possible underlying expectation of a linear-like development of L2 writing. The national subject curriculum does not express approval nor recognizes that the L2 development process is highly individual and that the learners will encounter periods of a perceived decline in their proficiency as the system is restructuring itself over time, which ultimately is a sign of L2 development per se. Therefore, one can contend that the results of this study might subsequently have implications for the wording in the national subject curriculum, but also raise awareness of stakeholders in English education in the Norwegian context to revisit their understanding of the true nature of L2 writing and attentively temporally anchored developmental trajectories.

Finally, the most pertinent pedagogical implication of this study is that its findings need to be communicated to English language teachers in the Norwegian context. There are relevant implications for language teaching practice from the findings that second language development is a highly individual and emerging process, but without awareness of such findings, English teachers are unable to develop their teaching methodology and practices efficiently. Especially the corrective feedback teachers provide to their L2 learners would be impacted by the findings of our research and those of similar studies. Learner variability may indicate language learning and the «errors» produced by learners may be an indication that they are experimenting with new forms of language use. Therefore, teachers ought to exercise patience when their learners exhibit variable L2 language output, as variability is key to L2 development and not least for L2 writing development.

7   Conclusion

In this master's thesis, we have investigated the development of writing skills of eight lower-secondary learners over a three-year period. We collected 10 text excerpts over a three-year period from each participant. 4 from eighth grade, 4 from ninth grade, and 2 from tenth grade. The types of texts collected from the participants range from argumentative texts to purely fictional texts. The main objective of this master's thesis is to answer two research questions "How does Norwegian lower-secondary learners' writing skills develop in terms of complexity and accuracy over a three-year period?" and "How does the measures of complexity and accuracy constructs interact with each other over a three-year observational period?". To answer these questions, we first had to establish our theoretical foundation. This master's thesis draws upon CDST as a theoretical framework, as many researchers argue that it permits and promotes system thinking in second language studies, thus disintegrates the dichotomous conception of important aspects of SLA, such as the cognitive versus social factors. The application of a CDST framework in this study is additionally motivated by the underlying premise that L2 developmental paths do not follow predetermined and prescribed courses; rather, they emerge through the interaction of numerous interconnected sub-systems, both internally and externally, and show novel properties which essentially do not belong to any specific system as such.

In light of the CDST framework, we utilized the CAF triad as a means to gauge the effect of L2 attainment over a three-year period (Housen et al., 2012). The CAF triad has been a natural companion in CDST L2 writing, due to the interconnectedness of the constructs, and their dynamic behaviour and changing interactions, as pointed out by Norris and Ortega (2009). We chose to focus on the construct's complexity and accuracy constructs as we were not present in the production of the texts, which are used in this study, thereby omitting the fluency construct was an ineluctable necessity for us in this research project. To gain a deeper understanding of how the writing skills of the participants develop over a three-year period, we invoked descriptive measures such as Word/Finite verb ratio, error types, and sentence type, and further to gain a deeper and newer insight about and understanding of how these parameters interact with each other we smoothed the data and conducted a moving correlation analysis.

The results in this master's thesis generally do support many aspects and features that are patently present in a complex dynamic system such as L2 development. All participants in this study show propositions such as a high degree of non-linearity and variability in the

developmental trajectory of both accuracy and complexity. To answer the first research question "how does Norwegian lower-secondary learners writing skills develop in terms of complexity and accuracy over a three-year period" we had to examine the developmental continuum for each participant in the study. As previously mentioned, we eschewed fluency construct in its entirety, and choose to focus on complexity and accuracy constructs as we and other researchers such as Rosmawati (2014) maintain that these two constructs can be used to explore not only the developmental continuum of the individual constructs in question, but also to gain an insight into how these two constructs, namely complexity and accuracy interact with each other over time. When examining the developmental trajectory for each participant it is clear that all participants experience a trajectory and path that arguably shows signs of non-linearity and to some extent is chaotic. However, even though that the continuum arguably shows signs of incline and decline, many of the participants do experience a big growth from the first assignment in eighth grade to the last assignment of tenth grade. In other words, a majority of the participants do experience an overall increase in both complexity and accuracy from the first assignment of eighth grade to the last assignment of tenth grade. In this master's thesis we do not explore other reasons than the general assumption we have made that L2 is dynamic and non-linearin nature. However, researcher such as Housen et al. (2012) argue that there is a plethora of factors that could affect the manifestation of the CAF constructs. Factors such as learner variables, type of pedagogical intervention, and other contextual factors, are argued to be impacting CAF constructs, and could thus be topics for further research withing the field (Housen et al., 2012, p. 9).

To answer the second research question, "how does the measures complexity and accuracy interact with each other over a three-year observational period?" we conducted a moving window correlation analysis which showed us that there were strong intraindividual variety from participant to participant. The apparent intraindividual variation is in line with the main axioms of CDST theory, where it is clear that the participants in this study do not follow predetermined courses nor reach the same end-state in terms of English writing ability. All participants in this study did experience a shift between positive and negative associations throughout the three-year period. However, as previously argued, these association varies greatly from participant to participant where some participants experience mainly strong positive associations between the complexity and accuracy constructs whereas other participants mainly experience strong negative associations. These high intra-individual trajectories are in line with studies such as Spoelman and Verspoor (2010), where they argue that "analyzing different degrees of intra-individual variability in different sub-systems of

accuracy and complexity has again been found to provide important insight into the process of Second Language Development" (Spoelman & Verspoor, 2010, p. 551). However, an interesting finding of this thesis, is that a majority of the participants mainly have a strong positive (above 0.50) or strong negative association (above 0.50), which signifies that complexity and accuracy in most cases in this particular study do interact with each other, and the fact that the participants in this study experience different developmental trajectories of L2 writing supports the notion within CDST theory that participants experience highly individual developmental trajectories which are arguably nonlinear and in many cases within this study do not develop collinearly. These findings are commensurable with a wide array of findings from researchers such as Larsen-Freeman (2006), Spoelman and Verspoor (2010), Polat and Kim (2013), and Rosmawati (2014). We were not able to discover any new findings, nor did we find any contradictory findings which are not commensurable with previous studies of similar nature and scope.

8   Recommendations for Further Research

The field of SLA and CDST in particular are still in an embryonic stage and would undoubtedly benefit from further research about L2 development and perhaps especially about L2 writing. As problematized at earlier stages in this thesis, the CAF triad has been the primary analytical tool to investigate dynamic and complex systems such as L2 writers, and as we have pointed out it has its limitations and potential flaws. Therefore, examining data using tools other than CAF to measure how each learner is developing might enable us to answer questions beyond complexity, accuracy, and fluency triad. According to Housen et al. (2012) several researchers have used the CAF triad as means to scrutinize the effects of areas such as effects of learning context, task design, and effects of instruction. However, in this master's thesis and other articles such as Larsen-Freeman (2006), the CAF triad is the central foci of investigation which according to Housen et al. (2012) has become more prevalent over several years.

In this master's thesis, we decided to not study the fluency construct from the analysis in its entirety. As we were not present in the production of the data and written texts that learners had written, we were not able to gauge fluency in a manner that allowed us to measure it properly and track its developmental trajectories in our participants, writing ability. Ideally, for further research, we would include measures for gauging the fluency construct. Traditional measures for measuring fluency are rate and length of output, which can be measured in rates such as number of words per minute (Wolfe-Quintero et al., 1998, pp. 13-14). However, Wolfe-

Quintero et al. (1998, p. 14) state that researchers can measure fluency "by considering the length of production units by counting the average number of words contained in them" as one would think that if a subject writes longer compositions the subject is arguably more fluent in a language" (Wolfe-Quintero et al., 1998, p. 14). However, in this research project, we decided to exclude the fluency construct altogether and further research should examine the fluency construct explicitly when investigating the developmental trajectory of L2 writing and probe into this interaction with complexity and accuracy with larger data sets.

Future developments in statistics and research design may also be anticipated. The future will ideally offer healthy synergy between group and individual investigations, where group findings will be tracked in individuals and vice versa, each understanding their limits and appreciating complementary contributions of each kind of studies. Additionally, the application of complementary qualitative analysis of the learner's writing quality could also provide and facilitate further understanding and possibly provide insight into the L2 writing development, an argument which is made by Rosmawati (2014) too.

Another important future direction for relevant research is to enable further analysis and study of the current longitudinal data that we have used in this work. For instance, manually programmed sequences might be used to create tools that automatically count them. Creating AI that could provide teachers and educators with the insight revealed by the analysis applied in this thesis, without the daunting task of carrying them out – could potentially revolutionize how teacher's asses their learners' written work. Additionally, new or a combination of automated metrics might be tested using the holistic scores of all the texts which are studied in this research.

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10   Appendices

10.1 Appendix 1: NSD Approval

Sikt

Notification form / Master thesis: Investigating Emergent Dynamicity and Developm... / Assessment

Assessment of processing of personal data

Reference number	Assessment type	Date
918234	Standard	25.04.2022

Project title
Master thesis: Investigating Emergent Dynamicity and Development of Complexity and Accuracy in Writing of Norwegian L2 Learners of English: A Complex Dynamic Systems Theory Perspective

Data controller (institution responsible for the project)
Nord Universitet / Fakultet for lærerutdanning og kunst- og kulturfag / Grunnskole

Project leader
Saeed Karimi Aghdam Ordaklou

Student
Kamilla Sundal Aspås

Project period
19.03.2022 - 30.06.2023

Categories of personal data
General

Legal basis
Consent (General Data Protection Regulation art. 6 nr. 1 a)

The processing of personal data is lawful, so long as it is carried out as stated in the notification form. The legal basis is valid until 30.06.2023.

Notification Form

Comment
OM VURDERINGEN
Personverntjenester har en avtale med institusjonen du forsker eller studerer ved. Denne avtalen innebærer at vi skal gi deg råd slik at behandlingen av personopplysninger i prosjektet ditt er lovlig etter personvernregelverket.

Personverntjenester har nå vurdert den planlagte behandlingen av personopplysninger. Vår vurdering er at behandlingen er lovlig, hvis den gjennomføres slik den er beskrevet i meldeskjemaet med dialog og vedlegg.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 30.06.2023.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra foresatte til behandlingen av personopplysninger om barna, og i utvalg 1 fra de registrerte selv. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte/foresatte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være foresattes/registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
Personverntjenester vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at foresatte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER

Personverntjenester vurderer at informasjonen om behandlingen som de registrerte og deres foresatte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18) og dataportabilitet (art. 20).

Vi minner om at hvis en registrert/foresatt tar kontakt om sine/barnets rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER

Personverntjenester legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

Office 365 er databehandler i prosjektet. Personverntjenester legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

MELD VESENTLIGE ENDRINGER

Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til oss ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:
https://www.nsd.no/personverntjenester/fylle-ut-meldeskjema-for-personopplysninger/melde-endringer-i-meldeskjema. Du må vente på svar fra oss før endringen gjennomføres.

OPPFØLGING AV PROSJEKTET

Personverntjenester vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Kontaktperson hos oss: Simon Gogl
Lykke til med prosjektet!

10.2 Appendix 2: Informed Consent Form

Would you like to participate in the research project

"Processes of multilingual development"?

This is a question for you, regarding whether your child would like to participate in a master thesis research project where the purpose is to investigate the developmental processes of youths writing abilities. In this form we are giving you information about the goals of this research project, and what participation entails.

Purpose
The project's purpose is to investigate how youths in ages 10-16 develop their writing abilities in English. The research will focus on three variables, namely complexity, accuracy and fluency. The findings in this project will form the foundation of our master thesis, which we are conducting as part of our teacher training program. the research questions are as follows

- How are complexity and accuracy developed in secondary school students' written English work?
- How do these variables interact over time during a three-year period of observation?

The information gathered will also be stored, to be used in a scientific publication on a later occasion.

Who is responsible for the research project?
Nord University is responsible for the project. The project manager is Saeed Karimi Aghdam Ordauklou, associate professor at Nord University.

Why are you being asked to participate?
The selection is randomised, however, there were some selection criteria: an extensive English program that archives its students' written work during their enrollment.

What does participation entail?
The project is a quantitative case-study investigation, based on observations of the participants' (students') written production in English over a three-year (or more) period.

For you as a participant, taking part will thus involve giving us access to your written work in English. The texts will then be obtained and stored digitally. Participation might also include an interview should it become appropriate. The interview is personal and notes will be recorded during the interview. The questions in the interview may be worded like this:

- How would you prefer to receive feedback and assessments on written work?
- Do written skills in English have value for you, values not linked to school and grades?
- Working on writing English, would you state that your focus lies on the writing process or the finished product?

As parents and legal guardiens, it will be possible to se the interview guide beforehand by contacting us.

Participation is voluntary

Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving any reason. All information about you will then be deleted. There will be no negative consequences for you, do you not wish to participate or later choose to withdraw consent. It will not affect your relationship with either us students or your teacher.

Your privacy – how we store and use your information

We will only use the information obtained about you for the purposes described in this form. The information will be treated confidentially and in accordance with the privacy regulations.

- At Nord University, only the thesis supervisor Mr. Saeed and the students signed below will have access to the personal information
- Several measures will be taken to ensure that no unauthorized person gains access to your personal information. Your name and contact details will be anonymised and replaced with a code, which will be stored on a separate list of names, separated from the other data. The data will be stored on an external service (cloud storage) with limited access.

Recognition of the participants will not be possible in the master thesis, nor in other scientific publications.

What happens to your information when the research project ends?

The project is scheduled to end in June 2023. at the end of the project, the personal information will be destroyed, storing only the coded data for use in future research.

Your rights

As long as you can be identified in the data material, you have the right to:
- access to which personal data is registered about you,
- to have personal data about you corrected,
- have personal data about you deleted,
- be given a copy of your personal data (data portability), and
- to send a complaint to the Data Protection Commissioner or the Norwegian Data Protection Authority about the processing of your personal data.

What gives us the right to process personal data about you?

We process information about you based on your consent.

On behalf of Nord University, NSD - Norwegian Centre for Research Data has assessed that the processing of personal data in this project is in accordance with the privacy regulations.

Where can I find out more?

If you have any questions regarding the research project or wish to make use of your rights, please contact:
- Nord University by Saeed Karimi Aghdam Ordaklou, email: saeed.karimi.aghdam@nord.no, phone: 74022909
- Students:
  Sander Ugedal, phone: email: sander.ugedal@student.nord.no
  Kamilla Sundal Aspås, phone: 94145970, email: kamilla.s.aspas@student.nord.no
- Our data protection officer: Toril Irene Kringen, phone: 74022750, email: personvernombud@nord.no

- NSD – Norwegian centre for research data, via email personverntjenester@nsd.no or phone: 55 58 21 17.

Best Regards,

Prosjektansvarlig   *Sander Ugedal*   *Kamilla Sundal Aspås*
(Forsker/veileder)   Student   Student

Declaration of consent

I, as a parent and/or legal guardian, have received and understood information about the research project «Processes of multilingual development», and have been given the opportunity to ask questions.

I consent to, my child_____(child's name):

- ☐ *Can have their written works in English, from a three-year period, collected and stored.*
- ☐ *Can participate in an interview.*

I consent to my information being processed until the project is finished, approximately June 2023

(Signature, date)