The temporality of learning through the lenses of Dasein and the dialogical self

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Writing has always been a unique, reflective, and educational journey for me. Despite undergoing the process numerous times in different languages, the beginning is always challenging as I need to arrange my thoughts in line with the task at hand. In this case, the task was to write my thesis. This thesis was an extensive writing endeavor that tested my analytical, intellectual, critical and creative thinking skills. While one could argue that such skills ultimately derive from life experiences, it would be ignorant to say that others did not play an important role.

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SUMMARY

The temporality of learning has garnered attention in the last decade. Although learning is understood as a process of growth that develops over time, learning is a personal experience that does not necessarily progress in a linear fashion. It may be difficult to determine which events in learning are important and if order matters. This study aims to investigate how students interpret the order and progression of time regarding their learning as well as how Dasein and the dialogical self theory (DST) can supplement this investigation. Dasein is an existential-philosophical concept that focuses on the significance of Being or existence, whereas DST is a psychological concept that focuses on the dialogical nature of the human mind.

In this study, discourse analysis was conducted using transcribed audio of 10 Finnish university students collaboratively learning in a technological learning environment. Discourse analysis was comprised of priming, layering, and coding. Priming reviewed the heuristics of discourse, layering incorporated Dasein and DST into the discourse, and coding identified temporal themes within the discourse. The results underscored that learning is not a linear process, and that mutual comprehension may be necessary in collaborative learning activities. Moreover, Dasein explained the nonlinearity of learning, whereas DST explained the discrepancy in mutual understanding of temporality.

The results suggest that collaborative learning may be better achieved by orienting the self with the present context towards a future through proactive discourse. Thus, teachers may want to encourage students to plan their group learning by discussing and aligning personal goals.

Keywords: Dasein, dialogical self theory (DST), temporality, discourse analysis, learning

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1   INTRODUCTION

The more time (hours, days, weeks, months, years) we spend doing an activity, task or action, the more familiar it tends to become. To facilitate familiarity, we initially break down the procedure into incremental steps by which we can gradually learn. This is because learning is essentially an ongoing and cumulative process of comprehension, command, or ability that matures over time (Mercer, 2008; Reimann, 2009). However, if we are to say that learning is a *process*, then we must also acknowledge that there is a *collection of events* by which the process itself is able to manifest. Thus, in order to understand the process of learning itself, we must not only adopt a holistic perspective on time but also an explicit perspective on temporality. The challenge for researchers in learning sciences is that both time and temporality are concepts and terms that remain difficult to capture and define for learning in the digital age (Knight, Wise, & Chen, 2017; Lämsä, Hämäläinen, Koskinen, Viiri, & Mannonen, 2020; Mercer, 2008; Quinton & Reynolds, 2018).

Consequently, researchers who are focused on computer-supported cooperative work (CSCW), computer-supported collaborative learning (CSCL) or technology-enhanced collaborative inquiry-based learning (CIBL), have employed different methodologies and technologies to investigate the temporality of learning. These include coding and counting (e.g., Chi, 1997; Kapur, 2011), Hidden Markov Models (e.g., Andrade, Danish, & Maltese, 2017; Soller, Wiebe, & Lesgold, 2002), epistemic network analysis (e.g., Csanadi, Eagan, Kollar, Shaffer, & Fischer, 2018; Lund, Quignard, & Williamson Shaffer, 2017; Saint, Gašević, Matcha, Uzir, & Pardo, 2020), lag sequential analysis (e.g., Bakeman & Gottman, 1997; Chen, Resendes, Chai, & Hong, 2017; Kapur, 2011), and, more recently, temporal lag sequential analysis (e.g., Lämsä et al., 2020). Interestingly, these studies operate using different, qualitative theoretical assumptions in cognition, community cognition, and small-group cognition (Stahl, 2013).

Knight et al. (2017) note that "temporality" in the "temporality of learning" in learning sciences is broadly captured through two main interpretations: "the

passage of elapsed time" and "the order of events without explicit reference to the duration of passage of time between them" (p. 8). However, the caveat with this definition is that it can reflect different theories of time because there is not an explicit preference on the particular order of the events in time. Nevertheless, it still highlights the fundamental feature of time: time is the collection of events that bring forth the perception of its progression or its absence, whereby temporality becomes a relative tool for measuring its events (Günthner & Deppermann, 2015; Prosser, 2016). This could explain why researchers in learning sciences approach the temporality of learning through different qualitative *and* quantitative research methods.

Moreover, an online search through various academic databases (see Attachment 1.0 for full details) reveals that the concepts of Dasein and the dialogical self theory (DST) are not used as *the main* theoretical framework in CSCW, CSCL, CIBL and/or related studies on the temporality of learning; despite their overall contribution to the fundamental role in understanding scientific theory and knowledge as well as the nature of human interaction (Peltoniemi, in press; Stahl, 2013). This gap is significant because researchers have noted that Dasein, or the existential-philosophical inquiry into our existence, can be used as a critical guide for conducting interpretive qualitative research (Horrigan-Kelly, Millar, & Dowling, 2016). Likewise, DST, or the psychological concept that underscores the significance of our inner, gregarious voices, can be used to probe into how students shift between identities and social positions while learning through dialogical considerations (Arvaja, 2015).

Thus, this study will revisit two theoretical frameworks used in learning sciences (i.e., Dasein and DST) to conduct qualitative research on temporality. Specifically, this study aims to examine the temporality of learning by analyzing the discourses of Finnish university students as they complete learning activities in a technological learning environment. Dasein will be used to interpret the existential and philosophical nuances while DST will be used to identify the interplay of voices within the self and their relationships to one another.

Overall, this study is composed of six chapters. In the introduction chapter, I will first provide an in-depth overview on the concepts and critique of Dasein

and DST. Next, I will address the conception, perception, and measurement of a time as well as its importance for Dasein, DST, and life in general. After doing so, I will provide illustrations to summarize the relationship that Dasein and DST have with time and space as well as how they all relate to education. At the end of the first chapter, I will list the three research questions of this study.

In the second chapter, I will first introduce the participants and data collection methods before discussing the function and application of discourse analysis in qualitative research. It is important to note that, in this study, discourse analysis was uniquely modified to include three distinct phases of analysis. Thus, I will justify the rationale regarding each phase as well as provide step-by-step instructions with examples. Following this, I will highlight the ontological, epistemological, and ethical considerations that were made during the research process.

The third chapter will focus on the results obtained through discourse analysis. The modifications made for discourse analysis in this study made it possible to answer each research question. Thus, the results will be divided into their own sections accordingly. The fourth chapter will be a discussion on the context and progression of this study and its results. The fifth chapter intends to review the limitations of this study as well as to provide suggestions for researchers interested in conducting similar research. In the sixth and final chapter, I will highlight the main findings from this study.

1.1   Heidegger and Dasein

Dasein is a philosophical concept created by the German philosopher Martin Heidegger, and it will be the key term in this section as well as one of the two theoretical frameworks in this study.

Much of the work by Heidegger has primarily impacted the development and understanding of modern European philosophy, phenomenology, existentialism, and education in general (Collins, 2000; Horrigan-Kelly et al., 2016, Koopman & Koopman, 2018; Sheppard, 2016; Stahl, 2013; Wheeler, 2020). What is perhaps less known are the connections between his thinking with theories outside of these fields. For example, some researchers apply Heidegger and his *ontic* inquiry of Being to understand the basis for different actions which teachers may take in their respective classrooms (see Hostetler, MacIntyre Latta, & Sarroub, 2007), while others use it to examine ethical dilemmas such as euthanasia (see Nuyen, 1990). Today, the works of Heidegger continue to impact research and thinking despite the complexity of his writing and some controversy surrounding his political affiliations during World War II (Collins, 2010; Wheeler, 2020).

For this study, the analysis and subsequent discussion on Heidegger will primarily derive from the seventh edition of his work *Being and time,* which was first published in 1927 and is said to be a masterpiece through its critical and highly original writing style (Smith, 1973; Wolin & Naess, 2020). *Being and time* challenged the ontological and metaphysical assumptions of the 19th century that had grown from the likes of Plato onwards through phenomenological or *ontic* inquiry (Naess & Wolin, 2020; Wheeler, 2020). Nonetheless, *Being and time* is an incredibly complex piece that even its translators admit how it poses a significant challenge to its readers whether they are reading the original version in German or a revised and translated version (Heidegger, Trans., 2001, p. 13). Indeed, philosophical texts can be inherently multifarious, but the intricacy with Heidegger lies in his creation of concepts originating from everyday words while also referring to words written using other languages such as Greek sometimes without any corresponding translation or romanization.

It is important to note that several key concepts introduced in *Being and time* were not originally created by Heidegger. For example, Heidegger draws on the concepts of "formal ontology" (reworded by Heidegger as "fundamental ontology"), "transcendental consciousness" (reworded by Heidegger as "Dasein"), and "intentionality" (reworded by Heidegger as "Being-in-the-world") by fellow German philosopher Edmund Husserl as well as the writings of Aristotle (Wheeler, 2020). Although Heidegger notes how the book is dedicated to Edmund Husserl, who paved the way for the branch of phenomenology and much of the groundwork for the writings of Heidegger, Heidegger still did not agree with everything that Husserl taught (Horrigan-Kelly et. al, 2016; Pihlström, Siitonen, & Vilkko, 2000; Wheeler, 2020). Moreover, despite the novelty and praise Heidegger has received over the years, a historical investigation reveals deep connections between his thinking and other notable philosophers, historians, and sociologists such as Aristotle, Georg Wilhelm Friedrich Hegel, Friedrich Nietzsche, Friedrich Hölderlin, Wilhelm Dilthey, and Søren Kierkegaard (Naess & Wolin, 2020; Rockmore, 2003; Stahl, 2013; Wheeler, 2020). For this study, I will be primarily focusing on what Heidegger himself had to say in *Being and time*.

Dasein is arguably one of the most important concepts presented in *Being and time*. Dasein is a German word created by Heidegger that consists of the German words "da" (here, there) and "sein" (being), and together they mean "being-there." When searching for academic articles on Dasein (e.g., Google Scholar), the word "Being" is often used as the translation for Dasein. While using the word "Being" may improve the fluidity of text written in English, it is still important to revisit the original word. According to Koopman and Koopman (2018), Dasein requires careful interpretation as Heidegger does not use the word in its literal German denotation (p. 5). This is not necessarily surprising since words, such as Dasein, are essentially utterances which may contain "propositional meaning, expressive meaning, presupposed meaning, and evoked meaning" (Baker, 1992, p. 13). Said differently, the meaning of any word or phrase may derive from a combination of the context, its way of use, formal

denotation or informal connotation. Heidegger intertwines each type of meaning as he probes into Dasein; hence its unique and complex writing style.

In simplest terms, Dasein is understanding the significance of existence itself or Being (hence capital "B") in which our own being (i.e., human being) is contained through *ereignis,* or the significance of their inseparable relationship. Dasein is understood by comprehending the finite, temporal human state or condition of limited existence through inquiry such as "what does (our) existence (i.e., Being) mean?" as we interact with other beings and entities (e.g., tools, objects, nature) in diverse social contexts (Horrigan-Kelly et. al, 2016; Hostetler et. al, 2007; Koopman & Koopman, 2018; Taylor & Francis Books, 2017; Wheeler, 2020).

In contrast to ontology which is a "description or inventory of the *things that are supposed to exist* according to a particular theory, which might but need not be true" (Jacquette, 2013, p. 3, emphasis added), Dasein critically revisits the assumptions of existence itself making it an *ontic* mode of inquiry. Heidegger was adamant that different fields of study (e.g., ethics, biography, philosophy, metaphysics) were perspectives that grossly overlooked the assumption and significance of existence in which we exist and observe phenomena (Horrigan-Kelly et. al, 2016; Shepperd, 2016; Wheeler, 2020). In particular, he rejected that human beings could observe objects or entities as subjects, a notion which had become common in Western philosophy and scientific thinking (Horrigan-Kelly et. al, 2016; Koopman & Koopman, 2018; Sturgess, 2016). Heidegger argued that temporal beings (e.g., human beings) and other non-temporal entities (e.g., inanimate objects in the environment) are mutually lodged in the existence itself. Thus, Being becomes an *ontic* method of inquiry that is developed through an understanding of temporality itself (Heidegger, Trans., 2001). Heidegger argued that if Dasein is at the forefront in scientific inquiry, it may be possible to reveal unique meanings and relationships between the different entities, animate and inanimate, in space as well as other aspects (e.g., mood) of our being through time.

Accordingly, the *ontic* investigation of Dasein has three aspects: sense-making, mood, and death (Koopman & Koopman, 2018; Hostetler et. al, 2007;

Taylor & Francis Books, 2017). These three aspects are intimately connected with another, and it is through their culmination that allows Dasein to manifest itself to itself as well as to us. The first aspect, sense-making, refers to the constant exploratory process of determining our Being within the various situations or spaces and relationships therein that human beings experience in daily life (Hostetler et. al, 2007). This process entails not just identity exploration but also the classification of "facts" or empirical observations presented before us by which may inspire or even pressure us to perform or refrain certain actions (Koopman & Koopman, 2018). For example, a person who is an athlete is not necessarily an athlete because he/she identifies as one, but perhaps because his/her parent was an athlete or because some friends encouraged the idea of becoming an athlete due to his/her exceptional performance at a local event. The person may also decide to reject the idea of an athlete altogether and pursue medicine in *hopes* of learning how to treat a terminally-ill friend.

Thus, one fundamental factor in making such decisions is emotion or mood. According to Heidegger, in any kind of situation, a person maintains a certain positive or negative mood, whether conscious of it or not, which can reveal, hide, or alter experiences and perceptions of [human] being in relation to Being (Koopman & Koopman, 2018; Taylor & Francis Books, 2017). It is important to stress that these moods are much more than statements of emotions such as "I feel happy." In fact, Heidegger adopts the Aristotelian notion of pathos or disposition and argues that moods are neither internal nor external in origin; they reveal "how one is" as they emerge from our "thrownness" in Being or the factual element of being-there (Sturgess, 2016, p. 32, Wheeler, 2020). Referring to the previous illustration, the change of heart from potential athlete to medical student is due to mood; a certain mood that is aroused through sense-making processes of Being in response to the context in question: the person *is struggling* with accepting the poor condition of his/her friend.

However, at the same time, the collision of sense-making processes and our projected or retracted moods derive from the third and final aspect of Dasein: death. Dasein is only made possible and complete through its finiteness or *temporality* as revealed by death. Through death, Dasein can ultimately confront

itself within itself (Heidegger, Trans., 2001; Mumford, 2013; Nuyen, 1990). Thus, the question of how people approach death or accept their finite being within Being itself demonstrates their level of authenticity or resolute, proactive understanding of Being itself (Horrigan-Kelly et. al, 2016; Taylor & Francis Books, 2017; Nuyen, 1990). When considering the previous illustration, the pursuit of medical knowledge could become questionable if done with the thought of "I must try to extend the life of my friend, it's not *yet* his *time* to go". Such thinking rejects the temporality of Being as well as fails to interpret authentically the totality of Being, allowing death to seize control over the power of Being (Koopman & Koopman, 2018; Nuyen, 1990; Taylor & Francis Books, 2017).

With its unique phenomenological approach, Dasein can be distinguished from the traditional branch of ontology in philosophy as it probes into the question of existence itself and how our existence is intrinsically interlinked with it. Dasein and its three aspects provide dimensions with which we can examine our sincere understanding of: existence, our role(s) in life and the function of objects around us, emotions and their significance, and the temporality of our existence. Even though Dasein seems difficult to approach given the labyrinthic writing style of Heidegger, it is important to realize that to pursue Dasein is to reveal "the meaning of everyday ordinary human existence," whereby we may enrich our overall understanding of the significance of life itself (Horrigan-Kelly et al., 2016, p. 7).

1.2   Hermans and the dialogical self theory (DST)

The dialogical self theory (DST) is another concept that allows us to understand the ordinariness of human beings but from the self and dialogical levels. DST will also serve as the second theoretical framework for this study.

Historically, DST has roots in pragmatic thinkers from the USA such as William James as well as dialogic thinkers from Europe such as Mikhail Bakhtin (Akkerman & Van Eijck, 2013; Hermans & Gieser, 2012; Raggatt, 2015). DST was first introduced in the 1990s by Hubert Hermans to synthesize the different, and sometimes conflicting, interpretations of the self, particularly personal identity

construction and transformation, in Western psychology (Hermans & Gieser, 2012; Hermans & Kempen, 1993). Despite using metaphorical explanations to explain the dialogical nature of human beings, DST has been applied in practice in areas such as developmental psychology (see Hermans & Gieser, 2012), as well as used to highlight consumer behavior differences between Japanese and Westerners (see 鈴木 & 阿久津, 2012). Today, DST has evolved to become an international research topic for researchers representing different fields with conferences held biennially since 2000 (ISDS, 2020).

At its core, DST states that the individual self of a person derives from multiple selves or a society that represents different persons affixed to certain instances of time, internal and external spaces. This results in a personalized anthology or collection of stories, each containing their own set of characters with motives, dispositions, and roles that interact with one another (Grossen & Orvig, 2011; Hermans, 2001; Hermans, 2008; Hermans & Gieser, 2012; Hermans, Kempen, & van Loon, 1992; Raggatt, 2015). In other words, our often-thought, wholesome construction of the self or primary identity is the amalgamation and reflection of varying inner selves or identities.

Each inner self or identity has their subsequent narrative that emerges and interacts through internal and/or external dialogue with one another depending on the progression of time and the location in space (mental or physical). For example, a person can *identify* that he/she is a parent, an athlete, and an introvert all at the same time; yet, it is when the person finds themselves in a PTA (parent–teacher association) meeting, at an athletic competition, or at a social dinner party does one corresponding *self* come forth more prominently in contrast to others. The same person can also have these inner selves interact or even compete with one another (e.g., If I am an athlete that enjoys competing with others, then how can I still be an introvert and be shy in other social situations?). Consequently, DST pays attention to the various positions of the self that emerge in such situations which are known as *I*-positions.

I-positions represent the array of internal or external stances or narratives a person may adopt or present in response to being in a certain setting and time (Akkerman & Van Eijck, 2013; Arvaja, 2015; Grossen & Orvig, 2011; Hermans &

Gieser, 2012; Raggatt, 2015). Here, "internal" refers to a personalized origin such as I-as-a-good-person, and "external" refers to a third-party origin such as I-if-I-were-my-mother. Arvaja (2015) highlights that *I*-positions often differ between people due to a consciousness shaped by dissimilarities in areas such as culture, history, and relationships (p. 138). Although we can share culture, history, and relationships, it is difficult for us to interpret and understand them in the same manner at the conscious level (Pihlström et al., 2000). The ability for culture, history, and relationships to manifest themselves is fundamentally achieved through our very existence. Said differently, it is through us and by us (i.e., Being) can we communicate history, produce offspring through relationships, and hear, feel, see, smell or taste the constituents of a given culture however they may be defined (Heidegger, Trans. 2001; Reeves-Ellington & Yammarino, 2010).

At the same time, deriving *I*-positions is made possible through human interaction or dialogue (Arvaja, 2015; Bakhtin, 1984; Günthner & Deppermann, 2015). After all, for a person to establish any kind of identity, DST argues that an inner or external spatial context in which he/she can compare himself/herself to others, is principally required. Being a parent is made possible by being responsible for another person who was biologically made through two persons. Being an athlete at a competition is made possible by the existence or supposed existence of other athletes. Being an introvert at a dinner party is made possible through the existence of an extrovert. Each of these *I*-positions ultimately sit on the spectrum of the various people within the broader community. Thus, even if we were to isolate ourselves physically from one another, we are never truly alone because we "live in a society of minds" (Dialogical Institute, 2010, 1:40).

However, like any community, opinions may differ among members on certain issues, and *I*-positions in DST also share this same fluctuating nature. DST argues that both emotion and reason are part of *I*-positions that communicate and negotiate with another depending on the situation (Akkerman & Van Eijck, 2013; Dialogical Institute, 2010). This means that the final or resting *I*-position in a certain context can result from an emotional or a logical *I*-position. Overall, *I*-positions can be separated into the following categories: *I-me, I-we, I-you,* and *I-it*.

In the *I-me* category, "I" is the current self and the "me" is the past of "I" that now functions as the object to which the "I" is compared (Cooper, 2003, Hermans & Gieser, 2012; James, 1890). For example, when a sober person thinks about their alcoholic addiction, he/she is examining the current (sober) self with the former (addicted) self. In the *I-we* category, the "we" represents a goal-orientated, collective representation of the self to which the individualized "I" is contrasted (Arvaja, 2015; Hermans & Gieser, 2012). This occurs when the person on a basketball team identifies the self as a pluralized version of self (e.g., we, the team) while also noting their personalized role on the team (e.g., I am the main offensive player for the team). In the *I-you* category, the "you" represents the generalized other or society that *encounters* the "I" creating a subject-subject relationship; whereas, in the *I-it* category, the "it" represents a *fragmentized* portion of the other or society through its objectivation (i.e., observation, experience) creating a subject-object relationship (Bakhtin, Trans., 1984; Cooper, 2003; Driver, Crawford, & Stewart, 2013; Hermans & Gieser, 2012; James, 1890). When a person observes the objects or people as mere entities in the environment therein, an *I-it* relationship emerges; however, when the person pursues the *it* (objects or people) as a unique entity or being with a specific role, an encounter with personal significance or distinct relationship emerges resulting in *you*.

One underlying and permeating source for the self to undergo such varying *I*-positions is the inherent feature of intersubjectivity (Akkerman & Eijck, 2013; Hermans, 2008). At a very basic level, intersubjectivity is the "interchange of thoughts and feelings, both conscious and unconscious, between two persons or 'subjects,' as facilitated by empathy" (Cooper-White, 2014). While some researchers have highlighted the various and inconsistent interpretations of intersubjectivity in social sciences (e.g., Gillespie & Cornish, 2010), this broad definition from the *Encyclopedia of Psychology and Religion* underscores the key points of DST discussed thus far. The dialogic interaction between the selves in DST reflect the varying entities (e.g., people, objects) that operate as the second subject/object in an *I*-position (e.g., *I-me, I-it*). These are brought about through the continuous and temporal interaction of the *interactees* in a particular space (Günthner & Deppermann, 2015; Hermans, 2008). Referring to the example above,

the former alcoholic "me" and present sober "I" both have their thoughts and feelings towards alcohol and the self, yet certain thoughts or feelings shift in conscious and/or unconscious prominence when at a bar at night or with family members at home during the day.

In exploring human beings, relationships, and internal and external dialogue embedded in human interaction, DST makes it possible to recognize the rich anthologies within us that we use to identify or objectify ourselves with other entities as well as to bring a sense of continuity in the varied, fragmented and spatial and temporal interactions in life. DST demonstrates that to understand oneself is to understand the community within us and how it may complement, coincide or even contradict the community outside us. Human beings are social beings, and DST asks the question: what is the nature of our gregarious disposition and how is it attributed to our self and the various communities in which we co-exist?

1.3   Critique on Dasein and DST

As we can see, Dasein and the DST are both concepts with which we can investigate human beings albeit from different bases of reasoning (phenomenology vs. psychology). Like any concept, theory, school of thinking or approach, criticism is bound to emerge, and the same can be said for Dasein and DST. This section will review some of the critique associated with each concept and/or its author as relevant for this study.

Despite the critical attitude Heidegger had towards philosophy during his time, a quick search of Heidegger today will reveal how his works are often discussed in philosophical circles (e.g., academic journals), and, thereby being subject to the very same critique. Despite his goal of bringing a revitalized understanding of philosophy, Heidegger employs unorthodox writing that breaks from philosophic logic by forcibly bringing forth concepts that are derived from everyday language (Smith, 1973; Wheeler, 2020). Heidegger and his writing become unconventionally accessible, insomuch that, without deciphering, Dasein is unable to demonstrate everything it claims to be and, in fact, results in

paradoxical explanations (Horrigan-Kelly et. al, 2016; Hill, 1990; Smith, 1973). For instance, Hill (1990) writes: "man is an 'ontic' fact to be studied empirically, and yet the *transcendental condition* for all 'ontic' knowledge" (p. 337). Interestingly, Heidegger also acknowledged his own frustrations regarding the writings of *Being and time*, and intended to write *Time and being* as a supplement, but never did (Wheeler, 2020; Wolin & Naess, 2020). However, imperfections and incompletions are not uncommon in ambitious writings, and do not necessarily invalidate the significance or use of a text altogether. They should serve as a reminder that they ultimately reflect the imperfections and incompleteness within us; hence, why research never ends.

Another important yet often-mentioned critique of Heidegger stems from his involvement with the Nazi Party prior and during World War II (Collins, 2000; Smith, 1973; Wheeler, 2020). This critique, however, requires slow and prudent analysis. Assigning guilt or heavy crimes to Heidegger by his political affiliation alone is simply an ad hominem fallacy. All writers operate in a context that is shaped by their experience in life and work which can be easily overlooked and judged through the lens of historical hindsight. The reality is that researchers of today continue to debate on his level of involvement and influence in the Nazi party (Collins, 2000; Wheeler, 2020; Wolin & Naess, 2020). For instance, although Heidegger was active in promoting Nazism ideology in 1933, historical records also indicate that he stopped a year later, and gradually distanced himself from the actions and policies of the party, while protecting Jewish books and rejecting the distribution of anti-Semitic flyers (Collins, 2000; Wheeler, 2020; Wolin & Naess, 2020).

Granted, Heidegger did have the seemingly ethnocentric attitude that the German people were destined to demonstrate the significance of Being (Wheeler, 2020), his writings have very little resemblance to the fascist and racist language of Hitler himself (Smith, 1973). Consequently, we are required to approach this issue from the lens of Dasein, which Heidegger himself argued was his main concern above all (Wheeler, 2020). Ironically, this consideration exposes one unavoidable fact: Heidegger omitted the importance of the beingness of the Jewish people as they walked into the gas chambers of the concentration camps

(Collins, 2000). This cold fact should remind us that, however sedulous and sincere we may be in our pursuit of knowledge, we cannot ignore the reality in which we conduct ourselves.

While DST has gained attention over the last decade through increased citations in research as well as the increased number of participants in the International Conference on the Dialogical Self, it still faces critique within the broader community of psychology. This is not surprising as, in contrast to Dasein, DST is actively practiced in fields such as social psychology, development psychology, and psychotherapy (Hermans, 2008; Hermans & Gieser, 2012; Suszek, 2017). This broad utilization of DST has led researchers such as Suszek (2017) to provide the following list of issues for DST: "devaluation of the idea of personality integration; devaluation of the idea of dispositions; discrepancy with popular feelings; the elevationist fallacy; the reductionist fallacy; anti-realism; diffusion of the boundaries of the self; weak empirical support; political bias; and the questionable model of mental health and methods of psychotherapy based on [DST]" (p. 97-98).

Furthermore, given the metaphorical writing style inherent to DST, Suszek (2017) is also concerned that the lines can become blurred between distinguishing multiple personality disorder or multiple identity disorder from DST. Despite such a long list of issues, Suszek (2017) does provide counterarguments for each one as well as concluding that DST is a developing and multidisciplinary theory whose future is yet to be written. This conclusion seems fair and logical considering how our understanding of the self and the human mind in general has progressed even thanks to the likes of Sigmund Freud (Jacobs, 2003).

Globalization, particularly advancements in technology such as the Internet, also presents a unique challenge for synthesizing DST (Hermans, 2001; Hermans, 2008; Hermans & Gieser, 2012). Hermans and Gieser (2014) have recently highlighted the complex "interfaces" that emerge between the localized self and the globalized world because of online interaction (p. 17). This discourse itself reflects the theme found in much earlier educational and international studies research (e.g., Jones, 1998; Sahlberg, 2004; Steger, 2003). However, "interface" is the key word which requires further attention.

The Internet is undoubtedly one key feature of globalization, and because of its rapid development in the last decade alone, it has become an integrative component in our daily life (Quinton & Reynolds, 2018; Rudman & Bruwer, 2016). In terms of DST, we can encounter numerous narratives that are only virtually or digitally accessible. This digital interface may be problematic for DST since research has found that general *sense-making* ability of information presented digitally or online as opposed to printed forms of media requires different skill sets such as ICT skills (Goldman, Braasch, Wiley, Graesser, & Brodowinska, 2012; Hahnel, Goldhammer, Naumann, & Kröhne, 2016).

In addition, polyphonic dialogue as introduced by Bakhtin (Trans., 1984) was based on analysis of printed media (e.g., books). Today, people engage in dialogue in *virtual spaces,* where the dialogue is virtually contained and displayed among the extensive noise or severely fragmented and asynchronous narratives based on mathematical AI calculations through user cookies (Peltoniemi, in press). For instance, when reading a personal blog on a website, you can see advertisements for losing weight, applying for an American green card, dating Japanese singles, understanding survival instincts of birds, learning Hindi, etc. all at the same time. While Hermans and Gieser (2014) discuss the myriad of cultural positions that emerge through interactions via the Internet, it is also necessary to consider the unique, cognitive load the Internet places on the mind as well as how its space, *cyberspace*, is uniquely juxtaposed between our physical spatiality and the inner spatiality of the mind.

While this section does not provide a complete overview on all the critique on Dasein and DST, the few points discussed should underscore the following, overarching themes. First, Dasein and DST exercise creative forms of writing and expressions that are atypical in their respective fields resulting in mixed reception from its audiences who, as Bruner (1991) would say, are used to achieving "verisimilitude" with relative ease. Next, both are multidisciplinary concepts that challenge the limits of our critical thinking and imagination. Finally, yet importantly, both tie into what is probably the most mysterious concept to explain: human consciousness (Van Gulick, 2018). Thus, the type of writing and

thinking inherent to Dasein and DST may be what we need to approach human consciousness.

1.4   The conception, perception, and measurement of time

Time and temporality are keywords that appear when discussing Dasein or DST. Indeed, both Heidegger and Hermans discuss the importance of time and space for investigating Being and the self respectively; yet, they employ different conventions in extrapolating the meaning and function of time. To better understand why such differences may unfold regarding such a universal concept, this section aims to provide a pithy overview on the common arguments regarding the conception, perception, and measurement of time in the 21st century.

In the modern era of scientific thinking, time is broadly conceptualized into two main rationales based on different ontological perspectives: A-theory or A-series and B-theory or B-series (Lockwood, 2005; Markosian, 2016; Prosser, 2016). The former states that time is tensed (i.e., past, present, and future) because "time passes and change is dynamic;" in contrast, the latter states that time is essentially tenseless because "time is closely analogous to space" (Prosser, 2016, p. 2). In other words, A-theory suggests that events in time are clearly ordered whereas B-theory suggests that events in time are only ordered by their corresponding, temporal relationship to one another and space (i.e., metaphysics). What is interesting to note is that this historical discussion continues today. For instance, Arto Siitonen in the book *Aika* (Time) shares the view with Aristotle that time has three principal components: "ennen [before]", "jälkeen" [after], and "yht'aikaisesti" [simultaneously] (Pihlström et al., 2000, p. 147). This view roughly echoes the B-theory since the present is simply not a point along the timeline because it is lived through as "dimensional duration" (Aristotle, Trans., 1992; Markosian, 2016; Pihlström et al., 2000).

Regardless of theory, time can be generally considered as movement or lack thereof depending on our perception of it (Prosser, 2016). In other words, we can perceive time to pass slowly, quickly, or not even at all. In fact, the realization of

time is often brought about through sensing a change in state such as feeling fatigued after work (Aristotle, Trans., 1992). Despite the subjectivity of time, it is measured using seemingly objective words such as days, hours, and minutes. We strive to implement different tools such as calendars, watches, and timers in our lives to measure time objectively so that we have some sort of consistency, regularity, and mutual understanding for arranging school, work, and social gatherings in life (Pihlström et al., 2000). But do such words and tools capture the passing of a time? For example, is the second hand on a clock moving slower or faster in conjunction with a second or the progression of time itself? This question itself has become more challenging to answer because new technology and scientific methods have improved to the point where we can empirically capture conceptually rare units of time such as zeptoseconds or 0.000000000000000000001 (10^{-21}) seconds (see Grundmann et al., 2020). This could explain why some scholars argue that the progression of time ultimately exceeds our observability because our visceral experiences of time are contained *within time*, i.e., such observations and related discourses are already temporal (Günthner & Deppermann, 2015; Pihlström et al., 2000).

Depending on the type of activity, we naturally value different units of time without considering how it reflects our sensitivity towards time itself. For instance, an elementary school teacher may draft a lesson plan by separating different sections of the plan based on a certain number of minutes and/or hours. A track coach, however, would instead focus more on milliseconds, centiseconds, and then seconds. Although both the teacher and the coach probably live their daily lives sharing the same conceptual units of time such as days, weeks, months, and years, it is *when* they engage in their respective activity of interest (teaching, coaching) does the interpretation and experience of the duration of time begin to differ.

Furthermore, research has shown that this engagement is not only a physical one but also a biological one through our *conscious* (Driscoll, 2014; Naya & Suzuki, 2011). Although our understanding of the brain continuously develops, explaining consciousness tends to entail theories and discourses from psychology *and* philosophy (Hoerl & McCormack, 2001; Markosian, 2016). One

important reason for this is that the mental activities of people regarding time, in contrast to spatial objects, are not absolutely defined. People can experience the same thought yet not necessarily the same conscious experience for such thought (Hoerl & McCormack, 2001; Pihlström et al., 2000). For example, two people of similar socioeconomic, religious, philosophical, educational, cultural, and linguistic backgrounds can watch together the same movie in the same setting at the same time, yet have a different conscious experience. Thus, one important and common method for us to ascertain the degree of shared experience is through discussion and "exchanging facts" through, e.g., concept maps (Kinchin, 2003; Pihlström et al., 2000, p. 80).

This discussion itself, however, is also a temporal form of interaction that is achieved by intersubjectivity of its participants who attempt to align their perception of time with another through various series of *retrospective* and *projective* narratives (Bruner, 1991; Günthner & Deppermann, 2015). Said differently, the basis for these narratives within these discussions are based on our own understanding of temporal and non-temporal entities, as well as how they relate with the self and one another in a certain context (Günthner & Deppermann, 2015; Heidegger, Trans., 2001; Hermans & Gieser, 2012). The two moviegoers can agree on how the movie was "action-packed" by highlighting and ordering various scenes in a discussion; however, the selection of a scene ultimately derives from how it is personally understood and relatable.

This discussion, albeit brief, has shown that the concept of time is, indeed, very difficult to define succinctly and without debate. Time as a concept may be universally shared, but its conception, perception, and measurement can vary both personally and scientifically. Although this paper aims to contribute to educational research, I have briefly included perspectives from physics, neurology, psychology, philosophy, and linguistics to highlight how time requires a multidisciplinary approach. Although educators may agree on the importance of managing time, educators may also need to consider how the conception and perception of time can vary individually and, thus, shape the overall educational experience.

1.5   Dimensional breakdown of Dasein and DST

One of the challenges for qualitative-based research is the need for extensive descriptions to reach a conclusion which can sometimes result in lengthy, convoluted writing (Suter, 2012; Tracy, 2012). To capture the central components of Dasein and DST, their relationship to time and space as well as to one another, in this section I will introduce dimensional levels of existence (e.g., 2D, 3D). I will refer to discussions found in physics and theoretical physics while including visual representations. This discussion is possible because dimensional discussion is part of Dasein and DST albeit in different configurations.

For instance, it can be inferred that Heidegger had in mind a dimensional perspective regarding Being itself. According to Wheeler (2020), "Dasein can stand back or 'out' from its own occurrence in the world and observe itself." It is spatially present while also *not* occupying our physical, Cartesian spatial existence because "Dasein is not *in space* so much as Dasein *is* space" (Sturgess, 2016, p. 32, emphasis added). Moreover, the temporality of Dasein and its understanding is, in fact, "specifically situated and historically conditioned" (Hostetler et. al, 2007, p. 234) in space. This is because "we are always immersed within a particular space of meaning, and that space has determinant effects upon the way we will not only understand what objects in the world mean, but indeed how we will permit ourselves to grapple with objects and beings at all" (Shepperd, 2016, p. 756).

Space, or lack thereof, and our being-there ultimately invites the discourse of how we are to interpret (sense-making), feel (mood), and reflect its relationship to and with us (death). Thus, the following visuals are *to illustrate* (not define) Dasein as it may reveal itself in varying, overlapping and emerging spaces and time. Heidegger was principally against visual representations in defining concepts. Moreover, the few illustrations that he did make himself have been difficult for researchers to decipher, as they were part of a lecture whose copy does not exist (Sturgess, 2016).

Likewise, the *I*-positions in DST are also "bound to *particular* positions in time and space" with space reflecting internal space of the self as well as the spatial or external space in which the physical self is contained (Hermans, 2001;

Hermans & Gieser, 2012, p. 15, emphasis added). In other words, *I-positions* are subjected to change from situation to situation, from mood to mood, from reason to reason within time through their dialogical negotiation (Hermans, 2001; Hermans, 2008; Hermans & Gieser, 2012). Because *I*-positions derive from the larger community of selves, in contrast to Dasein, the 'I' in *I*-positions "has no existence in itself", and it does not function as an omnipotent perspective by which impartial self-examination is conducted (Hermans, 2008, p. 188); hence, DST reflects the view that subject and object are separable.

For the following visuals, it is important to note that each "position" should be thought of as a "stance" rather than as a particular "location" in space because a shift in stance is dependent upon stimuli, often brought about by a shift in the social environment (Hermans, 2001; Hermans & Gieser, 2012). Thus, the visuals are meant to highlight the *transposition* of *I* in internal and external spaces by modifying the "Positions in a multivoiced self" figure as first introduced by Hermans (2001, p. 253). Furthermore, the underlying logic used in the following visuals should not be confused with the ones introduced at the Second International Conference of the Dialogical Self in 2002 (see Barresi, 2002).

First off, the nildimension (zero dimension) may be represented by a point in conceptual space (Figure 1.0). Despite visually appearing as an entity with measurable substance, it is, in fact, the very *absence* of it and everything; thus, it represents a *void* state of Being and the base from which any *I* stance is to emerge (Peltoniemi, in press).

Figure 1.0 Point

Dasein   DST
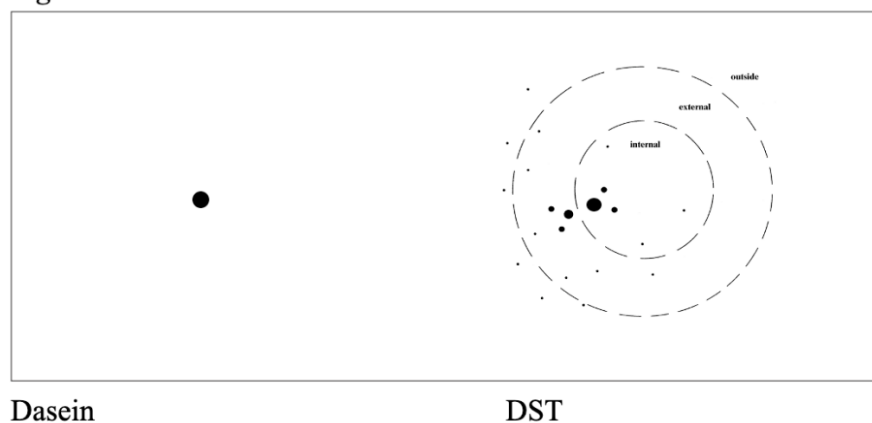
The first dimension may be represented by an axis which runs through points running in one direction in conceptual space (Figure 1.1). This series of points *merge* to create length; thus, it represents a *linear* state of Being and the branch which connects varying *I* stances in space (Peltoniemi, in press).

Figure 1.1 Line

Dasein   DST
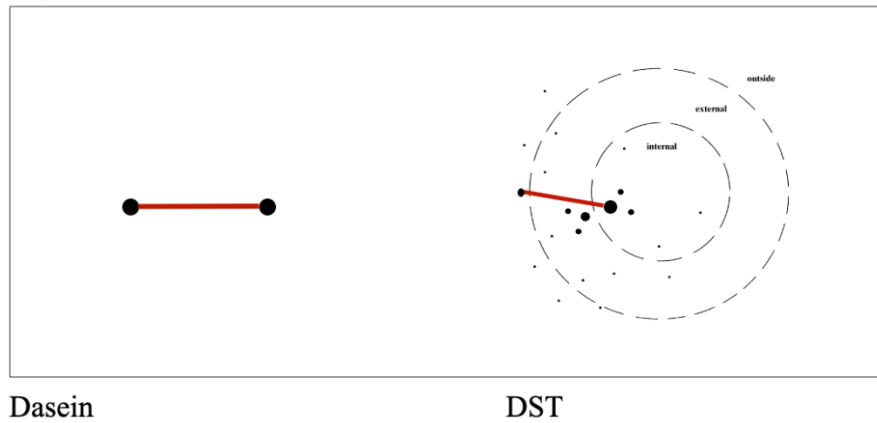
The second dimension may be represented by two axes which are 90 degrees from one another as well as to their respective points in conceptual space (Figure 1.2). Height and width *merge* to create area; thus, it represents a *planal* state of Being and provides the overlying boundaries for internal and external *I* stances (Peltoniemi, in press).

Figure 1.2 Square

Dasein   DST
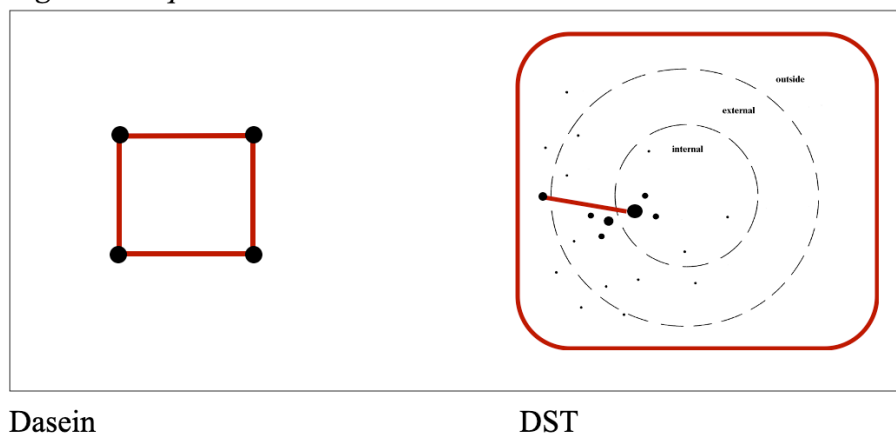
The third dimension may be represented by three axes which are 90 degrees from one another as well as to their respective points in conceptual space (Figure

1.3). Height, width, and depth *merge* to create volume; thus, it represents a *spatial state* of Being and the physical, and therefore, social environments in which the self and its respective *I* stances are spatially embodied (Peltoniemi, in press).

Figure 1.3 Cube

Dasein   DST
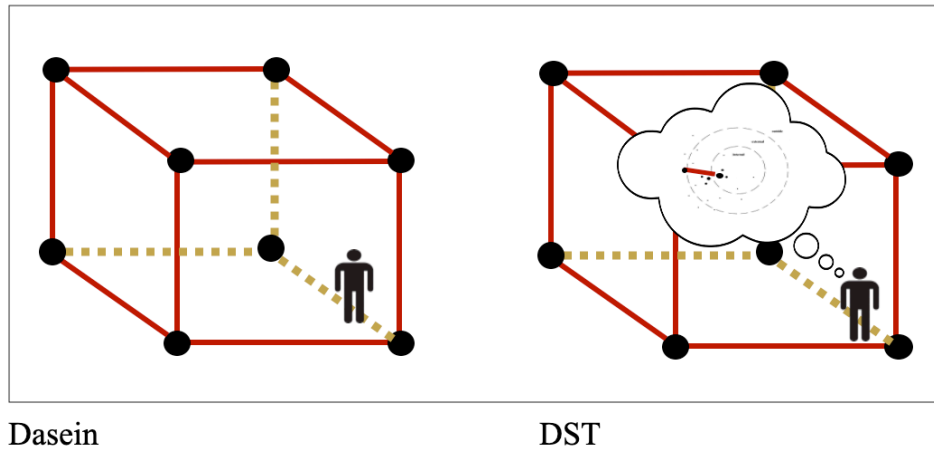
The fourth dimension may be represented by four axes which are 90 degrees from one another as well as to their respective points in space (Figure 1.4). However, height, width, and depth jointly *merge* with time to create duration; thus, it represents a *temporal* state of Being and the emergence of *movement* allowing the current "I" to become the new "me" in *I-me* (Peltoniemi, in press).

Figure 1.4 Tesseract

Dasein   DST
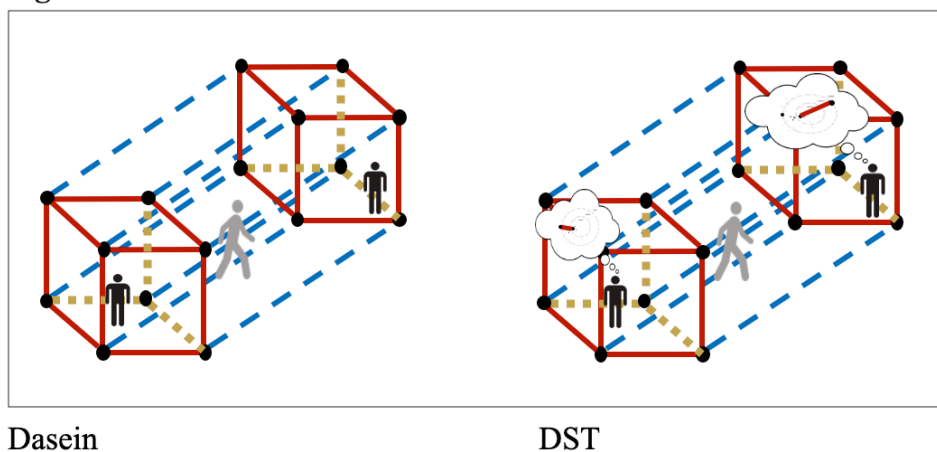
In theoretical physics, this dimensional discourse on existence may be expanded until the tenth dimension according to string theory. However, not

only do the visual representations of subsequent dimensions become rather cluttered for practical comprehension, but also their empirical validity, particularly from the fourth dimension onwards, remains contested in the general scientific community (Markosian, 2016; Ritson & Camilleri, 2015; Smolin, 2007). Pihlström et al. (2000) aptly summarizes the crux of this discord: "*…oleminen on (Metafysiikassa) määritetty ottamatta huomioon siihen kuuluvaa aikaa, ja aika on edelleen ymmärretty tästä lähtökohdasta käsin toissijaisella tasolla (Fysiikassa)*" […being (in Metaphysics) is defined without regard to time involved, and time is yet understood from this point at a secondary level (in Physics)] (p. 198). Consequently, I will stop with the visual representations at the fourth dimension.

The features of the fourth dimension remain particularly unique for DST and Dasein. While we measure the existence of the two cubes primarily through volume because of their spatiality, which coincides with our spatiality, as explained in 1.4, we can utilize numerous different units of time from different *directions* to measure the joining of these cubes (i.e., the tesseract) in temporality. Moreover, this can be done without affecting the spatial measurements of the original cubes. As a result, the length of time becomes relative for spatial existence.

For DST, this means that *I*-positions are independent in their categorical contexts defined in space, yet, at the same time, they are dependent on time which, by its progression, reveals their finite temporality in maintaining such positions; this ultimately reflects the Bakhtinian "incompleteness" of anthology for a person (Peltoniemi, in press). For Dasein, spatial existence and temporality form a relationship in which temporality interconnects history (the past), the present, and the future in which human beings can explore the authenticity of Being through temporal interpretations (Wheeler, 2020). Thus, the discovery of Dasein becomes possible through our perception of our own being and objects that are caught in the shifting spaces made apparent through time. When considering the figures above, it is possible to observe that the addition of each dimension unravels new perspectives of Being as well as captures the boundaries and transpositions of DST, which may not be possible otherwise should we

remain within a certain dimension. Interestingly, we manipulate these different Beings of existence and *I* stances therein, yet only to a certain, perceived extent.

For example, most teachers do some form of lesson planning which requires nonlinear thinking as teachers have to be able to think "upwards and downwards" in the teaching "staircase" (Haynes, 2010). In general, lesson planning entails: establishing educational objectives, assessing the needs of stakeholders (e.g., students, school curriculum) and available resources, creating applicable, relatable, and participatory contexts, and dissecting cognition (Fisher & Frey, 2011; Haynes, 2010). The consideration of stakeholders is DST in action as each stakeholder represents a different character narrating their unique needs. The teacher will, in a sense, need to listen to their voices while considering his/her voice in the mix as well as how they relate to the overall future *voices* that the lesson plan intends to bring out.

Dasein becomes particularly relevant when designing the learning materials. The learning material for children as well as young adults primarily consist of physical materials ranging from books to iPads, both of which contain two-dimensional displays of images, text, tables, and so on that are ultimately formed through lines connecting dots. However, print quality in printed material and pixel quality in mobile devices such as iPads are high enough today that any rough edges seamlessly connect to form a comprehensive shape. When students interact with a book or an iPad, they are *using* (temporal) a spatially present entity (object) to view a two-dimensional representation (shape) because of one-dimensional connections (lines) for a nildemensional entity (idea). In other words, students step backwards through each dimension to access and bring forth the entity (idea), which simultaneously exists and does not exist; this is Dasein in action, and perhaps a more *ontic* interpretation of scaffolding itself (Wood, Bruner, & Ross, 1976).

Nonetheless, due to the dynamic nature of human interaction, no lesson plan will truly be the same and or happen as planned (Haynes, 2010). It is here when we exceed the temporal limitations of the fourth dimension and transcend into the fifth dimension (i.e., different timelines). To draft a contingency plan for a lesson that *has not occurred* but *may occur* in more ways than one, we consider

the unknown voices of various beings through splitting and connecting multiple realities of space and time. For instance, a teacher may think, "if the warm-up lasts ten minutes, I will do activity A; but if it lasts 15 minutes, I will do Activity B instead, which means that I will need to have reviewed its contents later during the day only if my afternoon meeting is cancelled after going..." Therefore, teachers need to position themselves on multiple points from which they can bridge together varying configurations of time and space to handle the potential permutations of our future spatial-temporal existence. This ultimately requires the teacher to filter through varying *I* stances and their potential narratives while stretching their overall interpretation of Being.

The dimensional breakdown of Dasein and DST is an ambitious task which, I admit, will inevitably require further discussion. Nonetheless, the figures serve as practical illustrations to capture the essence of and differences between Dasein or DST. Time and space are concepts that are relatable to many of us, but for some thinkers, such as Hermans and Heidegger, time and space function as the elements by which people can understand the "human" in human being (DST) and the "being" in human being (Dasein).

1.6   Research questions

Temporality is an important element not only in Dasein and DST but also in learning sciences such as computer-supported collaborative learning (CSCL), computer-supported cooperative work (CSCW), and technology-enhanced collaborative inquiry-based learning (CIBL). Although temporality is not necessarily a new concept, learning sciences researchers have highlighted the need for continued investigation due to its complexity (Kapur, 2011; Knight et al., 2017). The primary aim of this study is to explore the relationship between learning and temporality as well as how we may capture them in our consciousness. However, since an investigation into human consciousness inevitably requires philosophical and psychological considerations, the secondary aim of this study is to examine temporality and learning through the

lenses of Dasein and DST. Therefore, this study will focus on the following three questions:

1. How do students interpret the past, present, and future in relation to their own learning while collaboratively completing learning activities in a technological learning environment?

2. Which, if any, aspect of Dasein is most prevalent in the interpretations identified in RQ1 and how does it supplement the current analysis?

3. Which, if any, *I*-position of DST is most prevalent in the interpretations identified in RQ1 and how does it supplement the current analysis?

2   RESEARCH METHOD

2.1   Participants and data

The data for this study derives from existing data at the University of Jyväskylä that was originally collected in 2016 and used in the articles Lämsä et al. (2018) and Lämsä et al. (2020). The total data consists of undergraduate physics students (both majors and minors) who enrolled in a basic-level physics course at the University of Jyväskylä in 2016. The data used in this study is based on 10 students (N = 10), who filled out a written consent form regarding their participation in the original study which only contained their pseudonyms.

At the beginning of the physics course, the participants were divided into groups by the course instructor with an average of five students per group for a total of two groups. In this study, the two groups will be referred to as Group A and Group B. Both groups consisted of different genders (male and female), mixed ages, and varying academic abilities. Each group was required to complete a series of learning exercises found in a technological learning environment. Although the course instructor was *not* involved while the groups completed the learning activities, the students within each group interacted face-to-face with another. Screencast-O-Matic software was used by each group to capture and record their audio while completing the learning activities. The body or physical appearance of the students and their physical learning environment, however, were *not* recorded. Then, the video and audio recordings were transcribed with a focus on content.

2.2   Analysis method

As explained in section 1.4, experiences can be shared between people yet uniquely perceived at the conscious level. Since discussion or discourse is a fundamental way to ascertain shared experiences between one another, this study will use discourse analysis to analyze the shared learning experience of the students. In this section, I will explain what discourse analysis is and how even Dasein and DST can be better captured through it.

First, at its most basic level, discourse analysis is a qualitative approach for studying language, as manifested in the social interactions of everyday life, whether in traditional form such as printed text or in semiotical form such as traffic signs (Gee, 2010; Johnstone, 2018; Wetherell & Potter, 1988; Wood & Kroger, 2000). Although grammar, lexicon, and syntax are important to consider in any discourse analysis, the goal is not necessarily linguist-centered (Wood & Kroger, 2000). Rather, discourse analysis aims to discover the "ways in which language constructs and mediates social and psychological realities" (Willig, 2014, p. 341). Discourse analysis states that we play a role in constructing the social reality or the world as we see through our interpretation (Gee, 2010; Wood, & Kroger, 2000; Raggatt, 2015). In other words, the discourse occurring in social interaction is shaped by the world, i.e., its *interactees*. Typically, the data for discourse analysis is derived from the recordings of dialogue as they occur in less structured settings (i.e., not formal interviews) as well as from written texts on websites such as blogs (Johnstone, 2018; Willig, 2014). The data is then further analyzed through different methodologies within discourse analysis such as institutional discourse analysis, conversation analysis, socio-linguistic analysis, cultural representation analysis, and narrative analysis (Willig, 2014). This study will conduct a thematic discourse analysis, whereby repeated interpretations of understanding or themes are identified within the discourse.

In terms of Dasein, Sturgess (2016) notes the fundamental question of "What is Being" is fundamentally achieved through "articulation of intelligibility" or discourse, which involves disclosure or the "act of moving something from being latent to manifest, from hiddenness to exposure" (p. 31). In other words, interactees aim to bring out the "realitiness" of reality through personal interpretations of various discourses that occur over time. The three aspects of Dasein (sense-making, mood, and death) are aptly captured within such discoursal interactions.

Sense-making of our being in Dasein or identity creation is achieved through conversation with others in social situations, in which we explain or reflect our current mood while (in)directly linking it to the finiteness of that identity itself as revealed through death (Hostetler et. al, 2007; Koopman &

Koopman, 2018; Taylor & Francis Books, 2017; Nuyen, 1990). For example, in the article "Retrieving mean in teacher question: The question of Being" (Hostetler et. al, 2007), each author engages in self-discoursal interaction to investigate their being as an educator (identity) and subsequent temporal (finite) moods therein. Within the framework of discourse analysis, Dasein functions to underscore the gravity of reality and its relationship with language and the mood of its interactees.

Similarly, DST involves multiple *I*-positioning or reflexive identity compartmentalization through dialogue which is bound by time and space (Arvaja, 2015; Hermans & Gieser, 2012; Raggatt, 2015). Time here refers to the temporality of interaction, and space refers to the social situations in which interactions occur as well as where *I*-positions emerge. Although *I*-positions may only occur within the mind and seem inaccessible from the outside, the identities manifest themselves, partly or wholly, in polyphonic dialogue through interaction (Bakhtin, Trans., 1984). The dialogues of these different *I*-positions often echo the utterances of real people representing different cultures, values, and positions in society (Arvaja, 2015; Günthner & Deppermann, 2015; Hermans, 2008).

DST also includes the adjective "dialogic" which comes from the noun "dialogue." Although researchers disagree on the constituents of dialogue in qualitative research, dialogue has similar ontological and epistemological elements to discourse analysis. According to Sullivan (2012), dialogue communicates knowledge that is created through "personal participation" of the interactee with society through conversation, having been instilled by the desire to understand their reality (p. 5-6). Thus, the combination of DST and discourse analysis actually "creates resources for studying the relationships between the self and the social that neither perspective alone provides" (Arvaja, 2015, p. 145). This is possible because DST focuses on the series of exchanges or dialogues of interactees at the *utterance level*, whereas discourse analysis focuses on the *collection* of these utterances.

Overall, discourse analysis allows qualitative researchers to investigate and approach the significance of meaning embedded in the everyday language that

occur in social and informal situations. Dasein and DST can also be explored through discourse analysis because of their respective considerations and values placed on discourse. Dasein communicates through discourse, whereas DST is revealed through discourse.

2.3   Phase I of analysis: Priming the data

While discourse analysis is a common research method in qualitative research, the complexity of this study has demanded my own original thinking. This was primarily due to being unable to find research examples that examine DST, Dasein, and temporality while using discourse analysis. As a result, I have modified thematic discourse analysis to have three different phases. Each phase contains several, cumulative steps that are based on a key rationale. All steps in each phase were repeated per data set (Group A and Group B).

The first phase involves "priming" the data for analysis. Priming here refers to the confirmation and preparation of data to ensure its viability with the proposed analysis method (Peltoniemi, in press). To begin priming, I reviewed section 2.2 with the research questions in section 1.6. After doing so, I turned my attention towards the data. I replaced all name initials in the transcript with a number (e.g., John becomes "1") so that I had 1, 2, 3, 4, 5 to represent the five interactees to better protect their privacy. Next, I defined the individual components of discourse as "utterance" to reflect the context of this research. In this study, utterance refers to either a complete or a fragmented verbal sound during a communicative turn made by an interactee that is brought about by thought, mood, or in response to the actions (verbal/nonverbal) of another interactee in a social situation (Peltoniemi, in press). For example, the statements of "Umm…did I...did I do something wrong?" in response to seeing my wife raise her eyebrows at me as well as "I can't think of anything else to buy, nope, nothing" in response to being asked by my wife if the grocery store list is complete would both be considered as two individual utterances.

Next, I counted the number of utterances made by each interactee as well as calculated their "share" in total utterances made. The data set for Group A

only includes Lesson 5: Task 6 and is represented by Table 2.0. The data set for Group B includes Lessons 5: Tasks 6 and 8, and it is represented by Table 2.1 and Table 2.2 respectively. Table 2.3 represents Lessons 5: Tasks 6 and 8 combined for Group B.

Table 2.0 Utterances by interactees in Group A (Lesson 5: T6)

	Interactee	No. of utterances	% of utterances
	4	9	6.87%
	5	17	12.98%
	1	19	14.50%
	3	32	24.43%
	2	54	41.22%
Total	5	131	100.00%

Table 2.1 Utterances and interactees for Group B (Lesson 5: T6)

	Interactee	No. of utterances	% of utterances
	5	17	7.73%
	1	25	11.36%
	3	46	20.91%
	4	60	27.27%
	2	72	32.73%
Total	5	220	100.00%

Table 2.2 Utterances by interactees in Group B (Lesson 5: T8)

	Interactee	No. of utterances	% of utterances
	5	6	5.94%
	1	12	11.88%
	2	16	15.84%
	4	27	26.73%
	3	40	39.60%
Total	5	101	99.99%

Table 2.3 Utterances by interactees in Group B (Lessons 5: T6 & T8)

	Interactee	No. of utterances	% of utterances
	5	23	7.17%
	1	37	11.53%
	3	86	26.79%
	2	86	26.79%
	4	89	27.73%
Total	5	321	100.01%

As semiotic interaction and body language had not been originally recorded, I wanted to obtain a rough idea regarding the level of interaction between interactees. From the perspective of Dasein, complete passiveness in verbal interaction, aside from acute listening, may indicate the passive, or inauthentic, recognition of reality (Sturgess, 2016; Taylor & Francis Books, 2017). From the perspective of DST, passiveness or proactiveness in verbal interaction is admittedly difficult to interpret because part of the dialogue that occurs among the selves in DST is internal (Hermans & Gieser, 2012). Nonetheless, at the same time, the complete absence of an utterance in the Bahktian sense, on which DST bases much of its original thinking, may mark the absence of reality for that person (Stamelman, 1987).

The next step in the priming process was to review the utterances several times and identify their heuristics as discussed by Johnstone (2018). In the third edition of *Discourse analysis,* Johnstone (2018) argues that there are six ways (Table 2.4) in which "discourse is shaped by its context" and "context is shaped by its discourse" (p. xxiv). While this process was quite tedious, it was necessary to ensure that the data in question exhibits fundamental features inherent to the discourse that is typically examined in discourse analysis. The six themes themselves also underscore the interpretive approach of research making it further relevant to Dasein and DST.

Table 2.4 Six heuristic themes for discourse

1. Discourse is shaped by the world, and discourse shapes the world.
2. Discourse is shaped by people's purposes, and discourse shapes possible purposes.
3. Discourse is shaped by linguistic structure, and discourse shapes linguistic structure.
4. Discourse is shaped by participants, and discourse shapes participants.
5. Discourse is shaped by prior discourse, and discourse shapes the possibilities for future discourse.
6. Discourse is shaped by its media, and it shapes the possibilities of its media.

(as seen in Johnstone, 2018, p. xxiv)

While referring to Table 2.4, I matched the utterances in the transcript with the six heuristic themes (Johnstone, 2018), by writing the letters A, B, C and so on, adjacent to the interactee (e.g., A [1], B [2], C [3], D [4], E [5], F [6]) in order to avoid confusion with the Arabic numbers that now represent the actual interacts (e.g., "C 4" instead of "3 4"). Utterances were labeled based on whether the first clause and second clause of a theme were both related between one utterance and, at least, the beginning of the following utterance. In other words, utterances are examined as discursive pairs, which again reflects the nature of discourse in discourse analysis. Let us examine Example 1.0 taken from Excerpt 1.0.

Example 1.0 (from Excerpt 1.0)
2: Tommonen ois siisti koodata.   *It'd be cool to code something like that.*   1: Mm.   *Hm.*

Interactee 2 makes an utterance having watched a video (media). Interactee 2 uses a verb specifically related to the video in question (to code) while also connecting it to another verb in the conditional form (It'd be) to highlight the potentiality and future of the media and its discourse. Interactee 1 makes a short utterance of "Hmm" and demonstrates *a response* to the interactee 2, but because it lacks actual words, the utterance reflects a passive if not a *non-discoursal turn* in the concurrent discourse.

After going through the transcripts several times, I discovered that all six heuristic themes were present. Let us examine Excerpt 1.0 which already

contained five themes and occurred after the members of Group A had watched a video prior to beginning a learning task.

Excerpt 1.0 (Group A, Lesson 5: Task 6)

F   2: Tommonen ois siisti koodata.
It'd be cool to code something like that.

D   1: Mm.
Hm.

B   3: Lukeeko siinä jotain?
Does it say something there?

B   4: Onks tuolla metriä per sekunti?
Is that meters per second?

D   1: Tota…
Well…

C   2: On.
Yes.

F   4: Okei. Mikä toi häkkyrä tuolla on?
Okay. What's that contraption over there?

E   2: Siis…Se… Tuo yksi partikkeli piirtää viivaa missä se kohtaa se on ollu.
So…it's…that one particle draws a line where it's been.

E   4: Ahaa, nyt mä nään.
Aha, now I see.

F   3: Niin tämäkö on nyt sitten se nopeus?
So, this here is its speed?

C   1: … jakauma
…distribution

E   3: Jakauma, joo.
Distribution, yup.

B   2: Vau. Mikä oli tehtävä?
Wow. What was the task?

F   3: Siis mikä se nyt on? Ajassa t atomi on ehtinyt törmätä, mitä siinä lukee, N on…
So, what is it now? The atom has managed to collide in time t, what's it say there, N is…

C   2: t per lambda per…v_{avg}.
t per lambda per…v_{avg}.

F   3: Jaha, joo. Jolloin atomin paikkavektori on siirtymien summa. Joo. Kyllä. Laskekaa, miten atomin siirtymän suuruus riippuu törmäyksien määrästä N… Eli ajasta t.
Aha, yup. So that the atom's displacement vector is the sum of displacements. Yup. Yes. Calculate how the magnitude of the atom's displacement depends on the number of collisions N… Over time t.

Next, I made a table that lists the exchange of utterances, the six themes and their respective interactees and overall frequency based on Excerpt 1.0 (Table 2.5). Again, this was done to review a sample of primed data and brainstorm further.

Table 2.5 Utterances and heuristics for Excerpt 1 (Group A, L5: T6)

	Interactee(s)	Theme	Frequency of theme
	N/A	A [1]	0
	2, 3, 4, (5*)	B [2]	3
	1, 2	C [3]	3
	1	D [4]	2
	2, 3, 4	E [5]	3
	2, 3, 4	F [6]	5
Total	4 (5*)	5	16

Although Table 2.5 does not represent a conclusive analysis for the entire discourse of Group A (Lesson 5: Task 6), we are still able to make a few observations. First, interactee 5 is entirely absent in the exchange. This could be the result in being responsible for operating the tools in the technological learning environment, but this is not clear. In either case, his absence could reflect theme B [2] (hence the * next to 5) because of his role in operating the mouse could have shaped the lack of necessity for discourse. The themes E [5] and F [6] need to be considered together. Students were focusing on learning activities which derive from the technological learning environment containing media (e.g., text, videos, images); hence, their questions and comments were circular since the same discourse continued. For example, interactee 4 asks, "What's that contraption there?" to which interactee 2 replies, "So…it's…that one particle draws a line where it's been." Linguistic C [3] structure also played an important role since several utterances were finished or confirmed by other utterances. For instance, interactee 3 indirectly asks, "So, this here is its speed?" to which interactee 1 responds only "...distribution." The single word response is possible because the word can replace the aforementioned "speed" without changing the grammatical structure and subsequent meaning of the original sentence.

Overall, the utterances within each data set contained the inherent features of a discourse typically examined in discourse analysis (Johnstone, 2018). Specifically, the discursive nature between the contents within a discourse and the overall direction of it was apparent when examining the utterances collectively or in pairs using the heuristic themes of Johnstone (2018). Having each theme appear more than once throughout each data also highlighted how

dynamic discourse can be over time, even if the physical (environmental) setting for the discourse remains the same. Therefore, priming has confirmed the correlation between the data and the assumptions found within the proposed analysis methods. Next, I will include the theoretical framework of this study.

2.4   Phase II of analysis: Layering the data

The second phase of analysis in this study involved layering the data. Layering the data refers to the alignment of the theoretical framework discussed in the literature with the heuristic themes (Johnstone, 2018) by connecting their respective discursive features (Peltoniemi, in press). In this study, layering was done between the three aspects of Dasein and the various selves or *I*-positions in DST with each theme.

This phase was very challenging because I was not able to find any prior examples of such synthesis. Despite this, the first phase has shown that the data is relevant for discourse analysis, and, as mentioned in section 2.2, Dasein and DST are both qualitative topics that value discourse of everyday language. While it seems theoretically possible to apply more than one aspect Dasein (sense-making, mood, death) and DST positions (*I-me, I-we, I-you, I-it)* to one heuristic theme (Johnstone, 2018), due to the limited scope of this study, I have chosen to write the most prominent aspect of Dasein and DST position (Table 2.6).

Table 2.6 Heuristic themes, Dasein and DST

Six heuristic themes (Johnstone 2018, p. xxiv)	Three aspects of Dasein (Sense-making, mood, death)	DST positions (I-you-me-we-it)
A [1]: Discourse is shaped by the world, and discourse shapes the world.	Death	*I-you*
B [2]: Discourse is shaped by people's purposes, and discourses shapes possible purposes.	Mood	*I-we*
C [3]: Discourse is shaped by linguistic structure, and discourse shapes linguistic structure.	Sense-making	*I-you*
D [4]: Discourse is shaped by participants, and discourse shapes participants.	Mood	*I-me*
E [5]: Discourse is shaped by prior discourse and discourse shapes possibilities for future discourse.	Mood	*I-me*
F [6]: Discourse is shaped by its media, and it shapes the possibilities of its media.	Sense-making	*I-it*

The first theme states that discourse, whether sensical or not, emerges from a reality that is assumed to exist and that is reciprocally interpreted by its interactees (Johnstone, 2018, p. xxiv). This theme relates strongly to the death aspect of Dasein which argues that how one approaches death, or time on this earth, fundamentally shapes the authenticity or inauthenticity of his/her discourse regarding the *reality* of Being (Taylor & Francis Books, 2017; Nuyen, 1990). The death aspect of Dasein echoes or conceals the broader picture of reality that one perpetuates which is discernible through his/her discourse with others.

As for DST, the first theme mainly correlates to the *I-you* position. Although *I-you* and *I-it* both represent an encounter between the self and the other (world), *I-you is* more applicable. Much of our discourse with the world is intrinsically done because of foundational triggers or intimate relationships with our other selves through, e.g., parents, siblings, husband or wife (Hermans & Gieser, 2012; Peltoniemi, in press). Concurrently, poor and disconnected relationships are not uncommon, which may lead to a sense of discontinuity, in which case the *I-you* reverts to *I-it*; however, the data for this study does not contain such instances. Thus, the table should be updated when dealing with participants who may have undergone a traumatic experience (e.g., burnout), that has resulted in a relational disconnect with those with whom one had been strongly connected.

The second theme states that discourse reflects as well as prescribes the reasons or basis by which we act (Johnstone, 2018, p. xxvi). The mood aspect would be appropriate here because, as discussed earlier, the sense-making action of *inquisitive* dialogue in our daily lives reflects our *thrownness* in the world, in which Dasein and ourselves are to confront one another by an expressed mood (Mumford, 2013; Sturgess, 2016). Moods capture the pretext for the actions we take as we either intend to acknowledge, refrain or confirm our perceptions of Dasein. Perceptions and understanding of Dasein is achieved through inquisitive actions from disposition (mood) within a discourse.

The keyword in the second theme for DST is "purpose." Of the DST positions, *I-we* reflects the underlying nuance and contrast of purposes within the self in contrast to other positions. Discourse in the *I-we position* involves balancing or negotiating the discourses containing individualized goals and collectivized

goals, both of which the self may experience at the same time (Arvaja, 2015; Hermans & Gieser, 2012). Let us think of a basketball game and its players. Both basketball teams play offensively to win, but within this offensiveness, there are still individuals who must play defensive. Such defensive players are balancing the discourse of winning through joint offense while practicing personal defense.

The third theme states that the linguistic structure in each language shapes our ability to conduct discourse while also being affected by the discourse that subsequently occurs (Johnstone, 2018, p. xxviii). This strongly relates to the sense-making aspect of Dasein. Heidegger himself was adamant that Germans were similar to the Greeks in that they are better able to probe into Dasein because of the unique characteristics inherent to the German language (Heidegger, Trans., 2001; Wheeler, 2020). This linguistic preference is further underscored by the fact that Heidegger was persistent in using Greek words in their original form as well as unraveling profound meanings from everyday words in German.

Linguistics is a peculiar topic in DST, because its role in shaping DST positions is not discussed explicitly. On one hand, Hermans (2001) argues how dialogue in DST should not be restricted to linguistic dialogue because of how important personal gestures are in discourse, particularly for babies and young children. On the other hand, Grossen and Orvig (2011) argue how "hedges, mitigators, and *other linguistic devices* that an interactee can use to modify, qualify, or even contradict his or her own discourse, can be regarded as *indicators of a sort of polemical dialogue* between the interactee and him- or herself" (p. 496-497, emphasis added). Despite the different arguments, both of them, nonetheless, still point towards the *I-you* position, because there is an encounter of significance. This can be achieved through touching such as a hug after saying "I love you" or through rhetorical devices to humble oneself in the presence of a respected person.

The fourth theme states that the *interactees* themselves form the discourse by which they are ultimately affected (Johnstone, 2018, p. xxix). Since the basis of theme four is the presence of other beings, the mood aspect of Dasein becomes most relevant. Dasein is able to find itself through manifestations of mood which are made apparent by us in our interaction with others (Heidegger, Trans., 2001;

Taylor & Francis Books, 2017). Dasein is concerned with the human experience in existence which can only be mutually shared or compared with other human beings by disseminating their respective moods.

In contrast to Dasein, participants for DST are mainly regarded as other selves despite having their fundamental roots in the society around the self. The *I-me* position becomes most relevant here because the current self (I) confronts the past or experienced self (me) to which other selves are connected, ultimately shaping the future *I* and subsequent *me* (Cooper, 2003; Peltoniemi, in press). Let us also not forget the practical point that the self is the *main* character within a sane mind that ends up concluding an opinion or behavior through dialogical interaction with itself, i.e., dialogical self (Dialogical Institute, 2010).

The fifth theme states that discourse builds upon previous ones which simultaneously creates opportunities for further ones to emerge (Johnstone, 2018, p. xxxi). As mentioned in section 2.4, discourse is imperative to Dasein, and it primarily emerges through the mood aspect of Dasein. Discourse is communication to mark the disclosure of our human experience in the light of Being which is brought about by our overall orientation or state of mind in such experience (Heidegger, Trans., 2001; Sturgess, 2016). Thus, the underlying passiveness or proactiveness within mood not only builds the foundation of discourse but also supplements its direction and continuation.

Discourse is also an inherent future to DST because of the dialogical interaction between the self and the selves. The challenge here is that much of the dialogical interaction that occurs, takes places within the mind of the self. Nonetheless, in any kind of discourse that occurs, there is an emotional undertone, a logical undertone or a combination of both. In DST, how a person responds to the undertone(s) chiefly depends on how they have/have not responded to it by negotiating the current self (I) with the past or experienced self (me) (Dialogical Institute, 2010; Peltoniemi, in press). Thus, the flow of one discourse to another is initially made possible through the *I-me* position.

The sixth theme states that media molds discourse and that discourse generates the boundaries of media (Johnstone, 2018, p. xxxi). Of the six themes, this one is particularly unique for Dasein because of the rapid changes in media

that have occurred in the last 93 years since Heidegger first wrote *Being and time.* Generally speaking, media is essentially the different mediums by which information is "somatically" or "symbolically" imparted to or by us (Ott & Mack, 2014, p. 1). Whether media exists in a physical form such as a newspaper or a digital form such as a website, it functions as another type of *equipment* for Dasein, by which human beings can orient themselves in reality as well as to recognize or dismiss Being (Heidegger, Trans., 2001); hence, the sixth heuristic theme reflects the sense-making aspect of Dasein.

As for DST, the discussion here is similar to the one found in the first theme. Media functions as information containing fragmented discourses by a myriad of entities to which the self encounters. While the self may discover or identify with a community within media, the depth of such relationships, overall, remain ephemeral in nature; hence, the sixth theme reflects the *I-it* position. Nonetheless, as I mentioned in section 1.4, our interface with digitized media, particularly with the Internet, is constantly and rapidly developing, so it is fair to say that the lines for DST regarding theme six will undoubtedly become contested in the future (Peltoniemi, in press).

Next, I revisited the transcript and added the corresponding aspect of Dasein and DST position under each theme, which I had written during the first phase. This was done to see how layering Dasein and DST complemented each theme (see Attachment 2.0 regarding layering logic). Let us revisit Excerpt 1.0 for an example (Note: SM = sense-making).

Excerpt 1.0 (Group A, Lesson 5: Task 6)
F   2: Tommonen ois siisti koodata. SM; *I-it*   *It'd be cool to code something like that.* D   1: Mm. Mood; *I-me* *Hm.* B   3: Lukeeko siinä jotain? Mood; *I-we* *Does it say something there?* B   4: Onks tuolla metriä per sekunti? Mood; *I-we* *Is that meters per second?* D   1: Tota… Mood; *I-me* *Well…* C   2: On. SM; *I-you* *Yes.* F   4: Okei. Mikä toi häkkyrä tuolla on? SM; *I-it*   *Okay. What's that contraption over there?*

E	2: Siis…Se… Tuo yksi partikkeli piirtää viivaa missä se kohtaa se on ollu.
Mood; *I-me*	*So…it's…that one particle draws a line where it's been.*
E	4: Ahaa, nyt mä nään.
Mood; *I-me*	*Aha, now I see.*
F	3: Niin tämäkö on nyt sitten se nopeus?
SM; *I-it*	*So, this here is its speed?*
C	1: … jakauma
SM; *I-you*	*…distribution*
E	3: Jakauma, joo.
Mood; *I-me*	*Distribution, yup.*
B	2: Vau. Mikä oli tehtävä?
Mood; *I-we*	*Wow. What was the task?*
F	3: Siis mikä se nyt on? Ajassa t atomi on ehtinyt törmätä, mitä siinä lukee, N on…
SM; *I-it*	*So, what is it now? The atom has managed to collide in time t, what's it say there, N is…*
C	2: t per lambda per…v_{avg}.
SM; *I-you*	*t per lambda per…v_{avg}.*
F	3: Jaha, joo. Jolloin atomin paikkavektori on siirtymien summa. Joo. Kyllä. Laskekaa, miten atomin siirtymän suuruus riippuu törmäyksien määrästä N… Eli ajasta t.
SM; *I-it*	*Aha, yup. So that the atom's displacement vector is the sum of displacements. Yup. Yes. Calculate how the magnitude of the atom's displacement depends on the number of collisions N... Over time t.*

In Excerpt 1.0, we can see several instances of how Dasein and DST add another layer of analysis to each theme. For example, the sense-making aspect of Dasein occurred primarily when the interactee was processing media in regard to their reality or when proactively affirming or inquiring facts (e.g., "So, what is it now? The atom didn't manage to collide in time t, what's it say there, N is…" and "So, this here is its speed?"). As found in Table 2.6, the DST positions connected to the sense-making aspect of Dasein were *I-it* and *I-you*. *I-it* complemented the fragmented or unattached relational perspective the interactee has with the other, which, in this case, was the technological learning environment (e.g., "It'd be cool to code something like that" and "Okay. What's that contraption over there?"). *I-you* was found mainly in the interrogatives or responses to interrogatives because of their linguistic features by which the self could confirm itself through the help of others (e.g., "Yes." and "So, this here is its speed?" which was followed by "…distribution" and "Distribution, yes").

By consulting Table 2.6, it was possible to layer Dasein and DST within each heuristic theme (Johnstone, 2018) that had been assigned in the first phase. While the themes in Phase I demonstrated the discursivity of discourse, layering (Phase II) unpacked potential precursors for such discursivity to manifest. The layered aspects of Dasein underscored the comprehension, emotions, and interpretations of interactees in discourse, whereas the layered DST positions underscored how

interactees consulted the other selves during discourse. Layering has also complemented the features of the data that are relevant for approaching the research questions. The research questions themselves will be addressed directly in Phase III.

2.5   Phase III of analysis: Coding the data

Because I have confirmed the presence of all heuristic themes (Johnstone, 2018) in the first phase and their corresponding connection with Dasein and DST in the second phase, the third and final phase focuses on coding the data. Coding the data refers to coding the discourse in light of the research context and theoretical framework (Peltoniemi, in press). The research context of this study pertains to the temporality within learning in learning sciences and the theoretical framework draws from Dasein and DST as explained thus far.

In general, temporality in discourse analysis can be approached by examining the utterances containing temporal elements such as grammar (e.g., verbs ending in -ed in English typically indicate the simple past tense) as well as temporal phrases such as *meanwhile*, *tomorrow*, and *before* (Johnstone, 2018). In this study, the temporal elements were examined by referring to the Finnish text rather than the English translation since the original discourse was in Finnish. In contrast to English, Finnish only has four tenses (present, past, perfect, and pluperfect) and it lacks a future tense (Oinas, 2011). Instead of having the future tense, Finnish indicates future action, possibility, or chance through: 1) verbs in the present tense with temporal adverbs, 2) verbs in the conditional form, 3) verbs in the potential form, 4) the verb olla (to be) with another verb using the present participle, or 5) the third infinitive (Kotimaisten kielten keskus, 2015; Oinas, 2011). Specific examples of each can be found in Attachment 2.1. Thus, I highlighted all verbs, modals, and temporal adverbs in grey. This also included the utterances in which the interactees read directions aloud, because, as discovered in the first phase of analysis, directions had played a role in shaping the discourse.

After doing so, I realized that there remained several untouched utterances, particularly those that were interjections such as "Mm." (Hm.). Since discourse

analysis is *not only* based on the formal linguistic features of a language, it is possible to consider utterances that contain other speech elements lacking formalized spelling or definitions such as interjections. This is also why they already have a heuristic theme attached to them since the first phase. Moreover, interjections remain relevant for Dasein and DST. For Dasein, interjections may communicate the gradual development of thought driven by mood to reflect the mutual experience of Being (Heidegger, Trans., 2001). For DST, interjections form the quintessential basis of knowledge by which the self can construct a reality and its subsequent *space* therein for the self (James, 1890).

In pragmatics research, interjections themselves can be categorized into primary interjections and secondary interjections. Primary interjections are non-words that are used exclusively on their own such as *hmph*, *ouch*, or *oh*. Secondary interjections are "lexical categories like verbs, nouns or adjectives which are used as exclamations and refer to mental acts, like *damn, god, hell*" (Meinard, 2015, p. 154, emphasis added). In contrast to primary interjections, secondary ones can be used alone or as a sentence. However, both types of interjections still "contain an implied predicative relation" (Meinard, 2015, p. 155). For instance, one can say, "Hell!" as well as "Hell! I don't know!" in response to a question. In both cases, the interactee demonstrates an illocutionary response such as "I am angry for being asked such a question." The challenge with considering interjections for this study, however, was ascertaining their temporality.

When considering an interjection as it is, indeed, it may be quite difficult to pinpoint its temporal feature. However, discourse analysis does not treat interjections as isolated utterances. Rather, discourse analysis considers *all* utterances as they relate to one another and to the broader discourse itself. This could be why Haselow (2019) argues that interjections can act as a temporal discourse marker, primarily by highlighting the beginning or end of a speaking turn for a topic (2019). Referring to the aforementioned example, the responses of "Hell!" and "Hell! I don't know!" may indicate that the current topic is displeasing for the person who made such a response and, therefore, does not desire further discussion.

In order not to disregard interjections that may have functioned as a temporal discourse marker, I underlined all interjections. I also did *not* classify interjections into primary or a secondary because of the context of this study and how linguistics debate on their true differences (Meinard, 2015). Underlining as opposed to highlighting also made it possible to easily overlap utterances that had already been highlighted for potential temporal elements.

The data for both groups was then reviewed several times to ensure all potential temporal elements (verbs, temporal adverbs, modals, interjections) were captured. Utterances which lacked apparent temporal elements were highlighted in cyan. The final step was to put these temporal elements together by referring to the interpretations of temporality as discussed by Knight et al. (2017).

First, I separated the various minor discourses within the major discourse of each data set. Major discourse refers to the *whole* collection of utterances made by all interactees in a certain setting (Peltoniemi, in press). For example, the major discourse for Group A would be the collection of all 131 utterances during the lesson. Minor discourse refers to the *partial* collection of utterances between at least two or more interactees who focus on a specific yet instantaneous topic that occurs within the flow of the major discourse (Peltoniemi, in press). For instance, the horizontal line between the grouped utterances in Excerpt 1.0 below represent three minor discourses, and Excerpt 1.0 represents the major discourse.

Excerpt 1.0 (Group A, Lesson 5: Task 6)
(1) F   2: Tommonen ois siisti koodata. SM; *I-it*   *It'd be cool to code something like that.* D   1: Mm. Mood; *I-me* *Hm.*
(2) B   3: Lukeeko siinä jotain? Mood; *I-we* *Does it say something there?* B   4: Onks tuolla metriä per sekunti? Mood; *I-we* *Is that meters per second?* D   1: Tota… Mood; *I-me* *Well…* C   2: On. SM; *I-you* *Yes.* F   4: Okei. Mikä toi häkkyrä tuolla on?

SM; *I-it*	Okay. What's that contraption over there?
E	2: <u>Siis…Se…</u> Tuo yksi partikkeli piirtää viivaa missä se kohtaa se on ollu.
Mood; *I-me*	So…it's…that one particle draws a line where it's been.
E	4: <u>Ahaa, nyt mä nään</u>.
Mood; *I-me*	Aha, now I see.
F	3: Niin tämäkö on nyt sitten se nopeus?
SM; *I-it*	So, this here is its speed?
C	1: … jakauma
SM; *I-you*	…distribution
E	3: Jakauma, <u>joo</u>.
Mood; *I-me*	Distribution, yup.

(3)

B	2: <u>Vau</u>. Mikä oli tehtävä?
Mood; *I-we*	Wow. What was the task?
F	3: Siis mikä se nyt on? Ajassa t atomi on ehtinyt törmätä, mitä siinä lukee, N on…
SM; *I-it*	So, what is it now? The atom has managed to collide in time t, what's it say there, N is…
C	2: t per lambda per…v_{avg}.
SM; *I-you*	t per lambda per…v_{avg}.
F	3: <u>Jaha, joo</u>. Jolloin atomin paikkavektori on siirtymien summa. <u>Joo. Kyllä</u>. Laskekaa, miten atomin siirtymän suuruus riippuu törmäyksien määrästä N… Eli ajasta t.
SM; *I-it*	Aha, yup. So that the atom's displacement vector is the sum of displacements. Yup. Yes. Calculate how the magnitude of the atom's displacement depends on the number of collisions N… Over time t.

I reviewed each minor discourse on their own and how their contents reflect the interpretations of temporality as discussed by Knight et al. (2017) while paying attention to the temporal elements that had been highlighted and underlined such as in Excerpt 1.0. When looking at the third (III) minor discourse from Excerpt 1.0, the interactees focused on identifying the contents of the learning activity. This is can be seen by comparing the temporal elements made by the interactees such as *oli* (was), *nyt* (now), and *on* (is), with the temporal elements that derived from the directions of the learning activity such as *on ehtinyt törmätä* (has managed to collide), *riippuu* (depends), *laskekaa* (calculate).

In the second minor discourse, the interactees focused on identifying or clarifying the visual component of the learning activity. This is underscored by the frequent exchange of yes/no questions and descriptions. For instance, interactee 4 originally asks about the unit and then the objects within the learning environment. The first minor discourse, albeit short, can still be distinguished from the other two as it relates to the technical dimension of the learning activity. Interactee 2 identifies the programming finesse required to make the video that is being watched by the group; however, it is abruptly ended by the interjection

of interactee 1, since the topic shifts to identifying the contents of learning activity, which is the second minor discourse.

By breaking down the analysis into three phases, it was possible to examine utterances and their discursive nature (priming), their relationship to Dasein and DST (layering), their structural composition in regard to temporality (coding). Priming ensures data reliability for the proposed analysis methods, layering ensures the appropriate connections between key theoretical frameworks and the data, and coding ensures that the analysis approaches the research context, aims and questions. These three phases have been methodically constructed so that they can be repeated in the same manner for each data set of this study.

2.6   Ontological, epistemological, and ethical considerations

Before addressing the results of analysis, here, I will discuss the ontological, epistemological, and ethical considerations made in this study.

For researchers to comprehend, interpret, or justify their work, deep and critical reflection on its very nature and rationale is required. Such thinking can be aided through philosophy, which is "critical thinking, of a more or less systematic kind about the general nature of the world (metaphysics or theory of existence), the justification of belief (epistemology or theory of knowledge), and the conduct of life (ethics or theory of value)" (Honderich, 2005; p. 666). Although it can be argued that many researchers of today employ well-established scientific methods for conducting research, philosophical thinking remains an integral part in the overall research process (Moon & Blackman, 2014). In the commonly illustrated tree of philosophy, ontology, epistemology, and ethics typically appear as separate branches; however, as I will briefly discuss in this section, the branches are intimately intertwined with one another, requiring the appropriate watering of the researcher.

The first branch is ontology, which is composed of the Greek words "onto" (existence) and "logia" (study or science), and it investigates the nature of being or existence which we deem as reality (Jacquette, 2002; Löfgren 2013a, 0:11; Tracy, 2012). In other words, ontology is interested in asking the most fundamental

questions in life such as "what makes reality be reality as we understand it?" Although ontology serves as the primary investigative lens for establishing truths or truth claims, researchers may have a preferred model or paradigm for reaching such understanding. A post-positivist paradigm argues that reality is "apprehensible" through "appropriate means," an interpretive paradigm may suggest that reality is hidden through its own "social construction," a critical paradigm underscores that reality is "constructed through power relations and shaped over history," and a postmodern paradigm states that reality is personally or communal shaped through its "multifaceted" nature (Moon & Blackman, 2014; p. 1169; Tracy, 2012, p. 48). Thus, the branch of ontology reflects the shape of reality, yet perceptions regarding its *direction* may vary.

Moving on, epistemology is a Greek word formed by "episteme" (knowledge or understanding) and logia (study or science), and it is the branch in philosophy that studies the nature of knowledge (Löfgren 2013b, 0:12; Moon & Blackman, 2014; Tracy, 2012). In other words, if we can establish that we are in a certain kind of reality or existence through ontology, then it becomes possible to make implications regarding the types of knowledge we create therein as well as their function. Therefore, epistemology is interested in asking questions such as "how do we get knowledge and what is its significance?" Just like ontology, epistemological understanding may also be viewed through different paradigms. A post-positivist paradigm sees knowledge as "true" and "independent" between subject and object, an interpretive paradigm conjectures that knowledge is "co-created" between subject and object, a critical paradigm considers knowledge to be hidden within "power relations," and a postmodern paradigm argues that knowledge is, actually, "relative" due the subjective nature of reality itself (Moon & Blackman, 2014; p. 1169; Tracy, 2012, p. 48). Thus, the branch of epistemology, although conceptually independent from ontology, can be viewed as the successive branch that grows alongside ontology.

The third important branch of philosophy is ethics. Ethics derives from the Greek word "ethos" meaning custom or character (PHILO-notes, 2018, 0:20), and *today* it is the branch in philosophy that "involves systematizing, defending, and recommending concepts of right and wrong behavior" (Fieser, 2020). Said

differently, ethics examines the means for our actions and how they reflect what we may consider to be good; this is not to be confused with morality which is the *actual practice* of ethics (PHILO-notes, 2018, 2:44). In the time of Aristotle, ethics was originally concerned with "what is good conduct for a good life," whereas ethics of today ask questions such as "what is good" and "what should people do and why (Fieser, 2020; Honderich, 2005)?" Like ontology and epistemology, ethics can be broken down into the following categories: normative ethics, metaethics, and applied ethics. One challenge in ethics is that many ethical issues such as abortion can fall into one or more categories as it is difficult to establish universal ethical standards (Fieser, 2020). In addition, ethics in scientific research is a recent development that was largely inspired by the Nuremberg trials between 1945 and 1949, which involved the discussion of the inhuman scientific experiments performed in concentration camps by the Nazi Party during World War II (Tracy, 2012). Thus, the branch of ethics continues to develop gradually, yet, at the same time, its growing importance casts a shadow on the actions that researchers take to define and demonstrate truth.

Having examined the fundamentals of ontology, epistemology, and ethics, I will now elaborate on my personal perspectives as well as how they have affected my research design. My overall ontological position is closely related to "naïve realism" (Moon & Blackman, 2014; p. 1169), as I share the view that reality and its nature can be concretely understood. Concordantly, my epistemological stance reflects that of a post-positivist, who sees knowledge as "objective" (Tracy, p. 48, 2012). As for ethics, I tend to consider issues from a meta-perspective, because I am interested in investigating the type of rights human beings have.

Due to my lifelong study of languages, I find myself shifting through discourses between the paradigms and categories when conducting research. Nonetheless, I have come to value the importance of linguistics in contextual considerations. I have learned that languages are a tool for communicating the various personal narratives of our feelings and experiences in life, however it is perceived, as well as the knowledge and ethical principles therein. For example, I have learned that English uses the verb "to be" to express the existence of animate and inanimate objects, whereas Japanese uses いる (iru) for animate and

ある (aru) for inanimate objects. The Chinese language expresses "I know" through the characters 知道 (zhidao) which literally means "realizing the road." The fundamental greeting of السلام عليكم (as-salamu alaykum) or "peace be upon you" in Arabic is strongly linked to those practicing religious worship, and therefore, alluding to ethics and/or moral behavior. Finnish uses multiple words to describe snow yet lacks a word equivalent to the "please" in English. Consequently, when I speak these languages and use them in their natural or native environments, I feel as though I am shifting my lens of understanding of the world, its knowledge and values.

As for ethics in research, standards may vary between institutions, regional governments, and countries (Tracy, 2012). Thus, one of the biggest challenges as an aspiring researcher is to ensure that I demonstrate enough rigor or careful and methodical attention to detail while adhering to: 1) procedural ethics as stipulated by the University of Jyväskylä as well as 2) situational ethics that may arise in the course of the research. To perform the necessary rigor, I have conducted an extensive, multidisciplinary and multi-modal investigation by examining various books, academic journals, videos, and illustrations from various databases, while consulting my advisor and other academic professionals at or associates of the University of Jyväskylä. Moreover, throughout the research process, I consistently checked and reported the procedures undertaken throughout the thesis process with my supervisor. Situational issues were also reported when they occurred. Finally, I checked the informed consent and privacy of research participants.

Finally, research also must be valid in that it employs a method by which others can replicate (Tracy, 2012). To do this, in the introduction chapter, I provided a comprehensive overview and illustrations to capture and summarize the theoretical framework as relevant to this study. In this chapter, I have carefully defined and described the analysis method while outlining important observations within each phase through concrete examples. Prior to the conclusion, the following chapters will describe the results with specific examples and appropriate figures, as well as address any limitations and recommendations of this study for future researchers.

3   RESULTS

3.1   Temporality and learning

In this study, the first research question was:

1. How do students interpret the past, present, and future in relation to their own learning while collaboratively completing learning activities in a technological learning environment?

By identifying the minor discourses within each major discourse, and then analyzing their thematic composition in relation to temporality of learning (i.e., Knight et al., 2017) while paying particular attention to the features of language, it was possible to identify the following three themes of temporality of learning: 1) confirmation of the present, 2) future prospects, and 3) hypothetical considerations. In other words, each theme of temporality of learning represents a different interpretation by which students perceived time in relation to their own learning while collaboratively completing learning activities in a technological learning environment. The number of relevant utterances for each group, task, and theme of temporality of learning are outlined in Table 3.0.

Table 3.0 Coding results: Utterances and temporal themes

Data set	Total no. of utterances	No. and % of temporal utterances	Utterances per theme (1-3)
I. Group A (Lesson 5: T6)	131	40 (30.53%)	27, 3, 10
II. Group B (Lesson 5: T6)	220	69 (31.36%)	19, 33, 17
III. Group B (Lesson 5: T8)	101	40 (39.60%)	26, 11, 3
Group B (Lesson 5: T6 & T8)	*321*	*114 (35.51%)*	*50, 44, 20*
Total/Average (I-III)	452	149 (32.96%)	72, 47, 30

As it can be seen in Table 3.0, Group A (Lesson 5: Task 6) had a total of 40 temporal utterances, Group B (Lesson 5: Task 6) had a total of 69 temporal utterances, and Group B (Lesson 5: Task 8) had a total of 40 temporal utterances. The total number of temporal utterances for both groups and the tasks was 149.

As for the distribution of temporal utterances per theme of temporality of learning, the first theme had a total of 72 utterances, the second theme had a total of 47 utterances, and the third theme had a total of 30 utterances.

In the following three sections (3.2, 3.3, and 3.4), I will explain further each theme of temporality as well as provide illustrations and relevant examples. After discussing all three themes of temporality, I will then unpack any remaining thoughts or questions that arise in their discussion by looking through the lenses of Dasein and DST. This will then allow me to answer the remaining two research questions of this study.

3.2   The first theme of temporality of learning

The first theme (Figure 3.0) discovered was "confirmation of the present," and it reflects the *passage of time* interpretation (Knight et al., 2017). Interactees attempted to define and understand the shared present while contextualizing the present and its reciprocal future through affirming factual, completed past events and/or ongoing events which started in the past. Thus, their learning was processed through the movement of time as opposed to how such movement is organized. As time and events progressed, so did their overall understanding of the situation develop.

Figure 3.0 Confirmation of the present theme
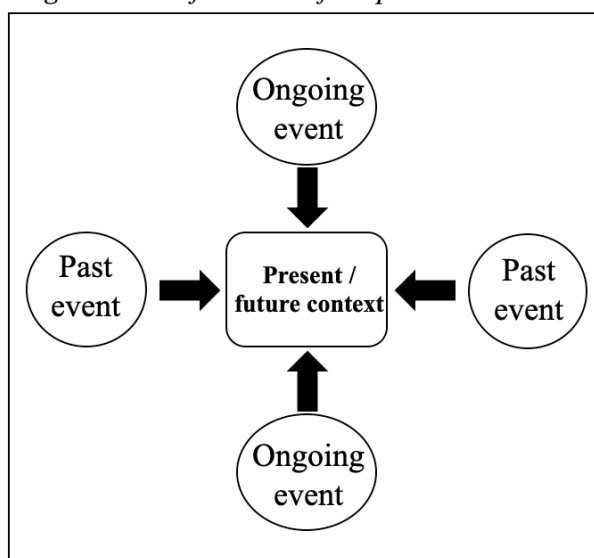
The first theme was the most prominent of the three with 22 minor discourses. The minor discourses often included utterances with *nyt* (now), *äsken* (just), *vielä* (still, yet), V~*taan/tiin* (is/was e.g., said), and affirmative utterances (e.g., Yes, it did!). Minor discourses and their utterances exhibiting the first theme are provided in tables below and in the following pages. The tables include all minor discourses and their utterances, in order, from Group A (Lesson 5: Task 6), Group B (Lesson 5: Task 6) and Group B (Lesson 5: Task 8). In other words, each minor discourse in each table has been numbered to identify its chronological order of appearance in relation to others belonging to that theme. For instance, the "(1)" in Table 3.1A below denotes the first minor discourse between both groups that was identified belonging to the first theme of temporality of learning. Moreover, the blank line following the English translation of the last utterance under "(1)" separates it from the following minor discourse (which would be "(3)" in Table 3.1A). This same style has been applied to other tables in this section as well as to the tables in sections 3.2 and 3.3.

The word "confirmation" in *confirmation of the present* is used to emphasize the frequent occurrence of interrogatives by interactees. In fact, of the 22 minor discourses belonging to the first theme of temporality of learning, 17 of them centered on a question. However, the types of questions varied within the 17 minor discourses. For instance, there were 9 minor discourses (1, 3, 4, 5, 11, 13, 14, 16, and 17) with questions regarding the directions of the learning activity or environment that had been displayed. Consequently, they were labeled as "Learning activity/environment-related question" and can be found in Table 3.1A below.

Table 3.1A Learning activity/environment-related question label
(1)   2: Vau. Mikä oli tehtävä?   *Wow. What was the task?*   3: Siis mikä se nyt on? Ajassa t atomi on ehtinyt törmätä, mitä siinä lukee, N on…   *So, what is it now? The atom didn't manage to collide in time t, what's it say there, N is…*   3: Jaha, joo. Jolloin atomin paikkavektori on siirtymien summa. Joo. Kyllä. Laskekaa, miten atomin siirtymän suuruus riippuu törmäyksien määrästä N… Eli ajasta t.   *Aha, yup. So the atom's displacement vector is the sum of displacements. Yup. Yes. Calculate how the magnitude of the atom's displacement depends on the number of collisions N... Over time t.*

(3)

2: Mm, mitä täällä kysyttiin? Vai sen niinku… Matkan riippuvuus siitä t:stä. Jees. Matkan riippuvuus ajast Miten täällä aika pitäis käyttää? ??? t on kääntäen verrannollinen N:ään.

Hm, what was asked here? Or it's like… The path dependence from t to here. Yes. The path dependence over time. How should time be used here? ??? T is inversely proportional to N.

3: Eihän. Suoraan.

Nah. It's directly.

(4)

2: Elikkä, meillä pitäis nyt määrittää, että onko matka… se matka suoraan verrannollinen tuohon??? N:ään(kö)?

So, we should now define whether the path…if the path is directly proportional to that??? L:ike this?

3: ???Paikkavektori? Siis onko tämä paikkavektori nyt, jos se liikkuu täällä näin (piirtää paperille)…?

???Displacement vector? So, is this now the displacement vector, if it moves here like so (draws on paper)…?

2: Mm?

Hm?

3: Nii, onko se paikkavektori sitten tämä…

Yea, so is the displacement vector then this…

2: Kyllä.

Yes.

(5)

5: Onks se se dt?

Is that the dt?

2: Joo, se on se. Se laskee sen siirtymän. Mut nyt me voidaan muuttaa tätä tänne näin, eli tätä täällä. (Muuttaa törmäysten lukumäärää 500 -> 700).

    [4: Mä katon tätä toista videota]

Kato vaikka se??? Katotaas, paljonko se nyt antaa. Nyt se on joku noin 11 (*10,9*). Nyt on pikkusen enemmän (*11,0*). Yksittäiset ei sano yhtään mitään. Nyt se voi olla paljon enemmän. Se on 28. Koska tämä oli ihan satunnainen systeemi, niin tämä on ihan p****stä.

Yup, it is. It calculates the displacement. But now we can change this to here like so, this here. (Changes the collision quantity from 500 to 700).

    [4: *I'll watch this other video*]

Why not watch it??? Let's see how much it will give now? Now, it is something like 11 (10,9). Now, it is slightly more (11,0). No specifics are given at all. Now, it can be much greater. It's 28. Because this system was so random, this is straight up bullsh**.

(11)

3: Nii. Joo. Miten atomi siirtymän suuruus riippuu törmäyksien määrästä? Pitääks meiän laskee se eka erikseen?

Yea. Yup. How does the atom's displacement size depend on the number of collisions? Should we calculate it first on our own.

2: Öö…

Umm…

4: Hetki pieni.

Just a sec.

(13)

4: Niin, elikkä tällä hetkellä se on mitä… Onks se 13, vai mitä siinä lukee?

Yeah, so at this moment, it is what… Is it 13, or what does it say there?

2: 13, joo – 13,4, ää, siis 8… 13,8.

13, yup – 13,4, aah, well 8…13,8.

4: 13,8 – okei.

13,8 – okay.

(14)

4: Itse asiassa se varmaan meinaa sitä, koska jos me laitetaan, tossahan on toi skaala, on -40:ssa 40:een, nii se on varmaan se skaala just…

> *Actually, it probably means that, because when we set it, there is the scale, there is -40 to 40:00, so it is probably the scale…*
> 3: Sitä paitsi siinä ??? on määritelty ihan niinku tehtävänannoss Vielä ylemmäs. Eiks se oo tota…
> *Besides that, there ??? it has been defined just as in the assignment. Up a little more. Isn't it, well…*
>
> (16)
> 4: Ilman atomien välisiä törmäyksiä Maxwell-Boltzmannin-nopeusjakaumaa ei välttämättä saavuteta.
> *Without the collisions between atoms, the Maxwell-Botlzmann speed distribution is not obtainable.*
> 5: Eli siis mitä?
> *Say what now?*
> 3: Ilman atomien välisiä törmäyksiä… Eiks se nyt oo…
> *Without the collisions between atoms… Isn't' that now the…*
>
> (17)
> 4: Sitte katotaan, että mihin se sitten tasaantuu. Se äsken oli joku 3,8?
> *Then let's see where it will even out. Wasn't it just something like 3.8?*
> 3: Eiku se oli yks piste…
> *No, it was one point…*

Next, there were two minor discourses (6 and 7) with questions regarding the appropriate task at the moment. These two minor discourses were labeled as "Task-related question" and can be found in Table 3.1B below.

> *Table 3.1B Task-related question label*
>
> (6)
> 1: Mitä me nyt lasketaan?
> *What do we calculate now?*
> 2: Siis tuossahan lukee suoraan, että mitenkä riippuu törmäyksien N määrästä.
> *So, it says right there, how it is dependent on the number of collisions N.*
>
> (7)
> 2: Tähän vaan nyt pitää tehä joku tilastollinen hässäkkä tästä, et saahaan siitä ees jotain järkevää aikaseksi.
> *What we just need to do here now is make some kind of statistical analysis from this mess, so that we can get something practical done.*
> 2: Lähetäänkö me vaan naputtelee tästä? Eikö?
> *Shall we start from clicking here? Right?*

The remaining six minor discourse (8, 9, 10, 18, 19, and 22) with questions focused on current understanding through indirect or direct discussion with other interactees. These six minor discourses were labeled as "Current understanding-related question" and can be found in Table 3.1C below.

> *Table 3.1C Current understanding-related question label*
>
> (8)
> 2: Nää nyt vaihtelee…
> *Now they change…*

3: Eli se mitä sä (2) teet, niin sä kokeilet N:n arvolla, mikä täältä tule
   [2: Joo.]
Ja sit se antaa ties mitä.
In other words, what you (Speaker 2) did, is to try with the value of N, which comes here.
   [2: *Yup.*]
Then it gives us, guess what.

(9)
2: Ni, tossa se oli nyt joku 20 noin pyöreesti [N:n arvo 300]. 700:lla se oli jotain vähän reilu 30. Kokeillaan nyt sillä 500:lla. Muutaman kerran naksuttelen tuota: 11, 15, 25, 21, 15, …
Yea, here it is now something like 20, rounded [The value of N 300]. *For 700, it was near 30. Let's try now with 500. I will click there a few times: 11, 15, 25, 21, 15, ...*
3: Eiks se on nyt saman suuruusluokkaa?
Isn't it the same order of magnitude?
2: No kyllä tää on pikkusen enemmän ku äsken. Se on satunnainen, niin se voi olla vähän mitä sattuu. Yllättävän pieniä.
Well, yes, this is slightly more than before. It is random, so it can be less by chance. Surprisingly small.

(10)
1: Eiks toi vapaa matka ollu niinku se keskiarvo?
Wasn't that free path like its average?
2: Nii, kauan se kerkee kulkee suoraan periaatteessa.
Yea, basically how long it can travel straight.
3: Joo. Mut eihän se tossa *(videolla)* pysy yhtään vakiona.
Yup. But isn't it there staying as a constant.
2: Ei. Ei. Niinhän tossa sanotaan, että… (Osoittaa tehtävänantoa, jossa sanotaan, että "tämä ei ole paras oletus, kuten videosta voi huomata".)
No. No. As it says there… (point towards the assignments where it says "this isn't the best assumption, as seen from the video.")

(18)
3: En mä tiiä, riippuuko… Miks se muuttuis? Tai miks se…
I don't know, does it depend… Why would it change? Or why it…
4: Kyl se aika samalta näyttää.
It sure looks the same.
3: Nii, eli false. Se paine ei oikein olennaisesti riipu siitä.
Yea, so false. The weight is not quite essentially dependent on it.

(19)
3: No eiks se nyt oo ihan? [Joo]
Well isn't it now completely? [Yup]
2: Nousee tossa.
It's going up there.
4: Kyllä.
Yes.
3: Kyllä. Tilavuutta pienennetään, niin poistetaan lämpöä. Se on totta.
Yes. When decreasing volume, heat is removed. It's true.
2: Jes.
Yes.

(22)
3: Eiks ne… Joo!
Aren't they…Yup!
2: Painovoima vaikuttaa enemmän…
Gravity is more influential…
3: Nii.
Yeah.
4: Kyllä vaan.
Yes indeed.
3: Nii se on. Joo. Eli true.

> *Yea it is. Yup. So true.*
> 4: Kyllä jos mietitään niinku, vaikka jotain hiilidioksidikaasua ja ilmaa
>   [2: Mm],
> niin kyllä niinku hiilidioksidi yleensä niinku tippuu alemmas.
>   [3: No niin. Painetaan submit.]
> *Yes, if thinking of, for example, some carbon dioxide gas and air*
>   [2: *Hm.*]
> *then of course carbon dioxide usually drops lower.*
>   [3: *Ok then. Let's press submit.*]

When looking at the remaining five minor discourse for the first theme of temporality of learning, two of them (2 and 15) focused on interpreting what the learning environment displayed. These two minor discourses were labeled as "Interpreting the learning environment" and can be found in Table 3.1D below.

Table 3.1D Interpreting the learning environment label
(2)
2: Se laskee meille jonkun…
It's calculating for us some kind of…
1: Ei laske.
No, it isn't
2: Laski! Siis toi on skripti, joka laskee, se niinku… Laskee tätä, mitä meiän pitäis laskee.
Yes, it did! So, that is the script, which calculates, it, well…Calculates this, which we are supposed to calculate.
5: Okei.
Okay.
2: Mutta tota… Tai siis se laskee sen etäisyyden… Satunnaisetäisyyden sieltä.
But, well…or it calculates the distance…The random distance from there.
(15)
2: Ei se oo välttämättä 56, se on jotain puolet tai… puolet 56:sta, koska meillä oli äsken sama…(silmukassa 200 kierrosta, mutta ka:n laskussa jaettiin summa 100:lla).
It isn't necessarily 56, it is half of something or…have of 56, since we had just had the same…(200 cycles in the loop, but the ka calculation was divided with the sum of 100).
1: Niin, äskenkin oli väärin.
Yeah, it was wrong just a moment ago.

The final three minor discourses (12, 20, and 21) for the first theme of temporality of learning focused on discussing how manipulating the learning activity will bring a future result to confirm their present understanding. These three minor discourses were labeled as "Learning activity manipulation" and can be found in Table 3.1E below.

Table 3.1E Learning activity manipulation label

(12)

3: Elikkä, me tiietään tuo r(t): se on tuolla sanottu, että se on tuo summa.

So, we know that r(t): it is mentioned there that it is that sum.

2: Joo.

Yup.

3: Ja sitten pitää laskee toi d, ku… Riippuu törmäyksien määrästä N. Se N on siellä summassa jo, sitä ei tarvi. Sitä ei tarvi mitenkään niinku sijottaakaan sinne. Pitääks meiän laskea se eka käsin vai, vaiko vaan computerilla?

And then required to calculate that d, whe…Depends on the number of collisions N. The N is still in the amount, ya, it is not necessary. We don't need it anywhere, so just put it aside there. Should we calculate it first by hand, or just with the computer?

2: Nii. Täs ainaki [Viittaa tehtävänantoon, jossa lukee "Hyödyntäkää alla olevaa skriptiä ja tarkastel-kaa, mahtaako laskusi pitää paikkaans"]. Nii.

Yea. At least here [refers to the assignment which reads "Take advantage of the script below and check whether your calculation is what it should be"]. Yea.

(20)

3: Ei oo pakko poistaa lämpöä. Jos sä laitat vielä lämmön tasaseksi.

It is not necessary to remove heat. If you set the temperature to even.

2: Ei pysty. Ei pysty.

Can't do it. Can't do it.

3: Ei pysty? Ah.

Can't do it? Ah.

(21)

4: Mut laitat sen gravityn pois. Toistaseksi…

But set the gravity off. For now…

3: Ei, mut nyt se…

No, but now it's…

Overall, interactees in the first theme engaged in learning through proactive inquiry or discussion on the progression of events which define the present and its subsequent future. When looking between the two groups for Lesson 5: Task 6 alone, the number of minor discourses between the two groups vary (Table 3.2).

Table 3.2 Distribution of minor discourses between groups per label for the first theme of temporality of learning

Label	Group A (L5: T6) Discourses	Group B (L5: T6) Discourses
Learning activity/environment-related question	1, 3, 4, 5	11, 13, 14
Task-related question	6, 7	-
Current understanding-related question	8, 9	10
Interpreting the learning environment	2	15
Learning activity manipulation	-	12
Total	**9**	**6**

As it can be seen in Table 3.2, out of the 15 minor discourses for Lesson 5: Task 6, nine of them are made by Group A compared to the six made by Group B. Furthermore, when looking at the five labels assigned to the discourses, Group A took the share for three of them. Group B only came close to sharing the "Learning activity/environment-related question" label with three minor discourses. Group B also only had one minor discourse for the "Current understanding-related question", "Interpreting the learning environment," and "Learning activity manipulation" labels. This means that Group A was more focused on *confirming the present* than Group B during Lesson 5: Task 6. When examining the final section of the major discourse for Group A (Excerpt 1.1), we can see that Group A had inputted the inappropriate answer for the learning activity. Consequently, it was followed by utterances in which the interactees remarked *continued* confusion and doubt on their learning.

Excerpt 1.1 (Group A, Lesson 5: Task 6)

1: Katotaan, mitä tää heittää… [Ryhmä lukitsee väärän vastauksen.] No ei tietenkään.
Let's see what this will give us…[The group confirms the incorrect answer]. Well, of course not.
4: Mut tai jos me oltais tätä kuinka pitkään mietitty, tai ainakin mä ehkä, niin en tiiä, mitä tästä ois tullu. ???
But what if we had thought about this longer, or at least, maybe, me, well I don't know what'd have become of this. ???
2: Ok.
Ok.
3: Selevä.
Alright.
1: Mutta ei tässä siltikään ole mitään fiksua.
But we are still not any wiser.
2: Emme osaa sanoa mitään järkevää tähän.
We cannot provide anything logical here.
1: En niele, mutta en ala tappelemaankaan tuon kanssa.
I won't bite my tongue, but I am not going to start messing with it.

In Excerpt 1.1, following the hypothetical remark of interactee 4, interactees 1 and 2 remark that they still do not understand what is happening and cannot provide supplemental explanation (e.g., "But we are *still* not any wiser" and "We cannot provide anything logical here"). Furthermore, interactee 1 concludes the major discourse of Group A with an utterance of reluctance on using the learning

environment to investigate further, even though Group A had relied much more on the learning environment for understanding the present than Group B.

3.3　　The second theme of temporality of learning

The second theme (Figure 3.1) discovered was "future prospects," and it reflects the *order of time* interpretation (Knight et al., 2017). Interactees attempted to understand and/or predict the shared future by identifying the necessary order of events for a certain, plausible outcome (future) to occur. In contrast to the first theme, learning was processed by organizing the units that comprise the movement of time. As different events of time were arranged towards a particular outcome, so did their overall understanding of the situation develop.

Figure 3.1 Future prospects theme
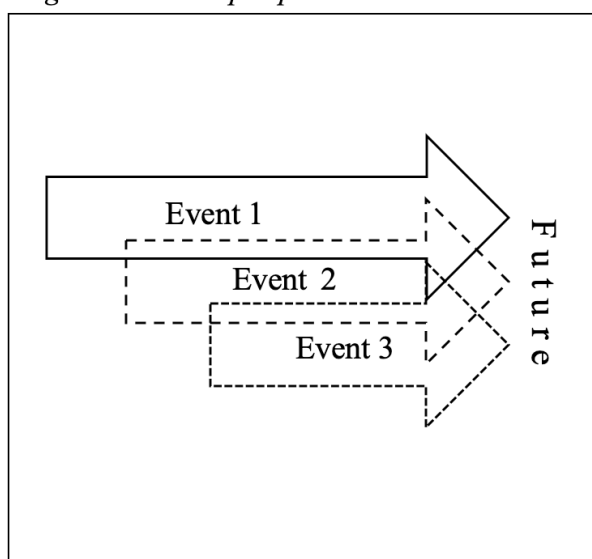
This theme was the second most prevalent with 13 minor discourses. The minor discourses often included utterances with *jos* (if), V~*taan* (let's e.g., see), V (contextual, *will* V), and situations where interactees completed or continued former utterances (e.g., one interactee says, "He didn't…" at which point another interactee says, "do that" to make the utterance, "He didn't do that"). Minor discourses and their utterances exhibiting the second theme are provided in tables in the following pages. Akin to section 3.2, the tables here include all minor

discourses and their utterances, in order, from Group A (Lesson 5: Task 6), Group B (Lesson 5: Task 6) and Group B (Lesson 5: Task 8).

The wording for the second theme also captures the overarching pattern within the minor discourses. Interactees were focusing on a near future or a potential future as well as synthesizing the order of the events for such futures or "short-term temporal contexts" (Lämsä, Hämäläinen, Koskinen, Viiri, & Lampi, 2021, p. 2). Interestingly, these futures were fundamentally connected to the situation at hand. For example, there were eight minor discourses (3, 4, 6, 7, 8, 9, 11, and 13) in which the interactees relied on the learning environment to reveal the expected future, often through inputting values. Thus, the minor discourses were labeled as "Learning environment-based future" and can be found in Table 3.3A below.

Table 3.3A Learning environment-based future label
(3) 4: Laitas uudelleen, ihan samalla. *Do it again, exactly the same way.* 2: Siis se aina menee ton yhen, vissiin. *So, it always goes there, I guess.* 4: Mut aja uudelleen, et jos kato, se on satunnainen, nii mitä sieltä tule – 49! (*N:n arvo edelleen 800.*) Okei. *But operate it again, if you look, it is random, so what comes from there. -49! (The value of N is still 800). Okay.* 3: Eli se rikkoo aika… Mitä jos sä laitat sen tosi pieneksi? *So, it breaks time… What if you set it to very low?* 1: Nii, jos pistää tyyliin 8. *Yea, so put 8 for class.* (4) 4: Kokeillaas nyt: 25 (*keskiarvo*), okei. *Let's try now: 25 (average), okay.* 5: Nyt kun ajaa sitä niil eri N:llä ja kattoo, mitä se keskiarvo on sitten. *Now it will run with those different Ns, and let's look at what its average is then.* 4: Jos heität sinne vaikka N:ksi satasen. Ja ajetaan, niin mitä tule. Äsken tuli 25. Nyt on viisi. *If you just throw something like 100 for N. And then run it, then what will happen. Just then it was 25. Now it's five.* 4: Eiku kaheksan, okei. *No, eight. Okay* 2: Voiaan laittaa näitä kierroksiaki enemmän, saadaan tarkempi. *We could set this in more loops, get it more precise.* (6) 4: Nii. Katotaas, mitä tapahtuu nyt (*N = 1000*). *Yeah. Let's see what happens now (N=1000).* 5: Aja sitä useemman kerran samalla N:llä. *Run a new turn with it using the same N.* 2: Mehän ajetaan tää moneen sataan kertaan. 200 kertaan samalla N:llä. *We are really running this several hundred times. 200 times with the same N.*

5: Aja – vielä.
Run it – still.

(7)
5: Jos ajetaan se sadan N:n välein.
If we run it every 100 of N.
1: Nii.
Yeah.
5: Plotataan pisteet.
Let's plot the points.
1: Mehän voiaan vaikka, mehän voiaan vaikka tohon vihkoon tai tauluun plotata se.
We could, for instance, we could, say plot it to that notebook or board.
3: Miksi sadan välein? Otetaan nyt vaikka ekat 400, eiku neljä eli sata, kaks, kolme, neljä. Niin siitä näkee hyvin.
Why every hundred? Let's take, say, the first 400, I mean four, so one hundred, two, three, four. Then it looks good.

(8)
2: Jos mennään 100 kertaa näitä ykkösen välejä täällä, niin…
If we go 100 times through these ones here, then…
4: Ja sen annetaan törmätä 100 kertaa ja sitten katotaan
[2: Nii],
aivan.
And then let it collide 100 times and then take a look
[2: *Yea.*],
exactly.

(9)
5: Näyttää aika lineaariselta.
Looks quite linear.
4: Mä meinasin just sanoo, et kyl se aika lineaariselta. Mut siitä me saahaan heti tietää, et onko se niinku neliöjuurellinen vai lineaarinen, jos sä heität siihen vaikka 2000 siihen N:ään.
I was just about to say that it's looking quite linear. But from it we can quickly tell whether it's square rooted or linear, if you throw 2000 in there for N.
3: Eiku siinä sanottiin, et se saa olla 1000.
Doesn't it say there that it can be 1000.
2: No… ($N = 1000$)
Well…(N=1000)
4: Pistä vaikka tuhat joo. Nii nyt se sitten nähdään, onko se kuinka lineaarinen.
Why not put a thousand yeah. So then we can see how linear it is.

(11)
3: Sit jos poistat kaikki ja laitat vaikka vaan…
So if you remove everything and just put, say…
4: Jos sä laitat vaan 200 niitä (*heavy species*) ja otat muut pois.
If you just put 200 of them (heavy species) and take the rest away.

(13)
4: Pistää molempiin sata ja sitten tota…
Put a hundred for both and then…
4: Tai 50 ja 50. Tai sat Ja annetaan sen hetken tasaantuu. Ja sitten pistetään painovoima päälle ja katotaan, mitä tapahtuu… Okei, nyt voi varmaan heittää ton gravityn.
Or 50 and 50. Or hundred. Let's let it even out for a second. And then let's turn on gravity and see what happens…Okay, no we can probably throw in the gravity.

The next two minor discourses (1 and 2) included complementary utterances as interacts made observations needed to predict the answer for the questions in the learning activity. These two minor discourses were labeled "Shared observations" and can be found in Table 3.3B below.

Table 3.3B Shared observations label
(1) 3: … Näistä ja N kasvaa. *…And N increases from these.* 2: Kyllä. *Yes.* 3: Niin se kasvais. *Yes, it'd increase.* (2) 3: Eiks se pitäis… *Shouldn't it…* 2: Tää pitäis nousta sillon. *This should rise then.*

The final three minor discourses (5, 10, and 12) for the second theme of temporality of learning included discussions of the events of a particular result needed to interpret the learning activity or its contents. These three minor discourses were labeled as "Events needed discussion" and can be found in Table 3.3C below.

Table 3.3C Events needed discussion label
(5) 2: Niin tota, eiks se oo järkevämpää, et jos niit on paljon niit törmäyksii, niin tota sillon… *Yeah, well, wouldn't it make more sense that if there were so many collisions, that would then…* 5: Lisääks se sinne tavaraa, ku me lisätään törmäysten määrää, vai ootetaanks me vaan pitempään? *Put more stuff there when we increase the number of collisions or shall we just take it further?* 4: Ei vaan siis, eihän toi niinkun varmaan vastaa tota yllä olevaa simulaatiota (videota?) mitenkään, tää vaan laskee satunnaisesti niinkun lukuja yhteen. *No, I mean, that surely answers that top part of the simulation (video?) in some way, this just calculates randomly, like, the numbers together.* 2: Siis, tää vastaa kyllä tota skriptiä, ku sehän arpoo tässä tota… Se tekee sen, sellasen tota taulukon, missä on x- ja y-koordinaatti ja sit on niitä kertoja tännepäin (vaakasuunnassa) N kappaletta. Sit se täyttää tässä sen taulukon sillä, että se ottaa satunnaisen kulman ja se kääntää sitä x:ää, y:tä jonkun satunnaisen verran. Tai niin. Ja sit se lisää sen siihen tota niinku seuraavalla. Sit ku se on täyttäny sen, nii se plottaa sen silleen, että se käy ne kaikki pikku viivat täältä läpi. Ja sit se vissiin laskee tästä tonne sen matkan. *So, this does answer the script, because it drew lots from here… It does it in that table, where the x and y coordinates are and then their multipliers this way (in the direction of the scale) of N. Then it fills up the table so that it takes the random angle and changes its x and y to a random amount. Or so. Then it adds there that for the next one. When it is filled, then it plots it there so that it passes through all the small lines from here. And then, I guess, it calculates the distance from here to there.*

(10)
1: Mä luulisin, että se pysyy samana koko ajan se jakauma, jos ne ei törmää, koska niitten kaikkien nopeudet pysyy samana siinä. Ja sillai sitä…
I would think, since it stays the same the whole, the distribution, if they don't collide, it's because all the speeds stay the same there. And then it…
3: Nii, mutta sillon niiden nopeudet voi olla mitä tahansa.
Yea, but then the speeds could be anything.
1: Nii, ja sillohan sitä ei saavutet. Välttämättä.
Yea, and then it is not obtainable. Necessarily.

(12)
3: Mut siis, et se lämpötila voi pysyy ihan samana, jos se…
But then the temperature can stay the same, if the…
5: Tilavuus kasvaa…
The volume increases…
3: Tilavuus saa…
The volume gets…
4: Tilavuus kasvaa, nii se on false.
The volume increases, so it is false.

In contrast to what was observed in the first theme of temporality of learning, in which interactees focused on the present through past events during Lesson 5: Task 6, here interactees experienced learning through comprehending the order of events from the present to a certain future.

Table 3.4 Distribution of minor discourses between groups per label for the second theme of temporality of learning

Label	Group A (L5: T6) Discourses	Group B (L5: T6) Discourses
Learning environment-based future	-	3, 4, 6, 7, 8, 9
Shared observations	1	2
Events needed discussion	-	5
Total	**1**	**8**

As it can be seen in Table 3.4, when looking between the two groups for Lesson 5: Task 6, the number of minor discourses between the two groups has a reciprocal pattern to what was seen for the first theme of temporality. Out of the nine minor discourses for Lesson 5: Task 6, eight of them are made by Group B as opposed to one made by Group A. The one minor discourse made by Group fell into the "Shared observations" label, and it was matched in number with Group B whom also had one minor discourse. The bulk of minor discourses for

Group B fell into the "Learning environment-based future" label. In other words, Group B had more *expectations for a certain future* than Group A during Lesson 5: Task 6. When examining the final section of the major discourse for Group (Excerpt 1.2), Group B had inputted the appropriate answer for the learning activity. Thus, their utterances exhibited compliments and confidence.

Excerpt 1.2 (Group B, Lesson 5: Task 6)
2: Tota joo. Nii, elikkä tämä? (neliöjuuri)   *Ok, yup. Yeah, so this? (square root)*   3 & 4: Joo.   *Yup.*   4: Samaa mieltä. Olen samaa mieltä itseni kanssa.   *Agreed. I agree with myself.*   2: Jes. Hyvä ty… pojat.   *Yes. Good wor… boys.*   4: Hyvä pojat ja tyttö.   *Good boys and a girl.*

In Excerpt 1.2, following the joint confirmation by interactees 3 and 4, interactee reaffirms the approval by verbalizing a personal agreement ("I agree with myself."). Interactees 2 and 4 then conclude the major discourse for the group by taking turns in complementing one another. Although Group B also relied on the learning environment during the learning activity like Group A did, Group B focused more on extrapolating the possibilities of the future.

3.4   The third theme of temporality of learning

The third and final theme (Figure 3.2) discovered was "hypothetical considerations," and it reflects the *configuration of time* interpretation (Peltoniemi, in press). In a unique hybrid of the first two themes, interactees attempted to establish certain, personalized timelines to meet a shared outcome by manipulating the passage of time and/or events in time. Thus, learning was processed through customizing the movement of time and the units that comprise such movement. As time and its events were reconstructed, so did a tentative understanding of the situation develop.

Figure 3.2 Hypothetical considerations theme
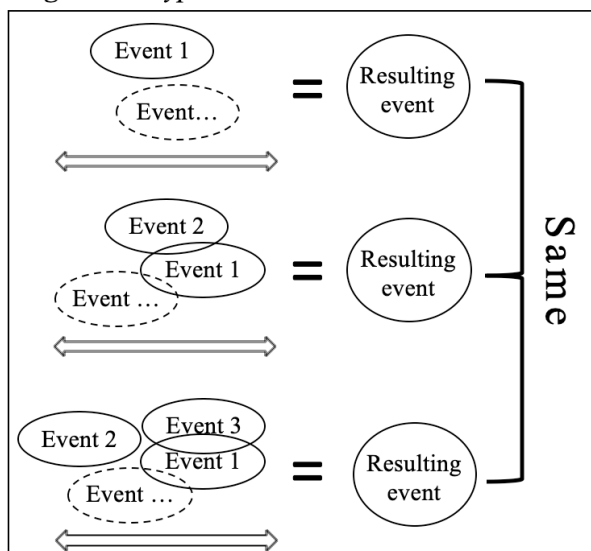
The third theme was closely behind to the second theme with 11 minor discourses. The minor discourses often included utterances with *saattaa* (may), *voi* V (may e.g., be), *väittää* (would argue/suggest), and *olisi* V (would e.g., do). Minor discourses and their utterances exhibiting the third theme are provided in tables in the following pages. Akin to sections 3.2 and 3.3, the tables here include all minor discourses and their utterances, in order, from Group A (Lesson 5: Task 6), Group B (Lesson 5: Task 6) and Group B (Lesson 5: Task 8).

Of the three themes, the third one was the most challenging one to discern from the first two themes. Nonetheless, I have chosen the word hypothetical because it captures the fluctuating shift between the past, present, and future. The 11 minor discourses in this theme were hypothetical statements in which the present and future where primarily discussed. When looking closely, the 11 minor discourses can be divided into two. On one hand, there were six minor discourses (1, 3, 4, 6, 10, 11) in which interactees focused on the order and length of events for a certain "present". These six minor discourses were labeled as "Hypothetical present" and can be found in Table 3.5A.

Table 3.5A Hypothetical present label

(2)

1: Jos äkkiseltään miettis, niin tuosta kun kertoo nuo termit keskenään… Tai tuon kertoo tuolla itellään, pistetulo, niin siitä tulee noitten kaikkien pistetulot ittensä kanssa plus sitten kaikkien niinku ristiin menevät pistetulot. Ja nuo ittensä kanssa, niin sillä se pituus on tuota… verrannollinen tuohon t:hen, elikkä se tulee t:n neljäntenä neliönä sisälle ja sitten nuissa kaikissa on kuitenkin pituusterminä t neljään niin sitten tuo dt olis ite suoraan t:hen verrannollinen.

If taking a second to think, then from there when explaining those terms with each other…Or that explains itself there, the dot products, so that from there all dot products themselves in addition to all the crossing dot products. And those with themselves, so that the length is, umm…directly proportional to t, so that it turns out as the fourth square inside and then, in each one, there is the length term t to the fourth so that dt would itself be directly related to t.

2: Eli sä väittäsit, että se on suoraan verrannollinen.

In other words, you suggest that it is directly proportional.

1: Kyl mä voisin heittää. Ihan näin niinku villi veikkaus.

Yea, I would venture a guess. Just a stab in the dark.

(3)

3: Mihin ne ristitermit häviää sitten, tai siis?

Where did the cross-terms go then, or what?

1: Ei ne ristitermit häviä. Ne voi olla, että ne vie sen takas nollaan tai ne voi olla, että ne tuota…ne kasvattaa sitä. Periaatteessa se tarkottas, josse satunnaisesti ottas suunnan tuota… öö… niinku poispäin tuosta pisteestä, niin sillonhan se täytys olla selvästi tuohon t:hen, mutta se voisatunnaisesti myös ottaa suuntaa takasin päin. Eli paras arvaus ois tuo t. [M muuttaa skriptissä N:n arvon 700 -> 300.]

The cross-terms never went anywhere. They could be present, because they brought it back to zero or they could be, that they umm…they increased It. In essence, it'd mean, if it randomly took a direction well…uhh…like so from that point, so that it would clearly have to be for that t, but it could also randomly take direction and come back. So, the best guess would be that T. [Speaker 2 changes the value of N in the script from 700 to 300.]

(4)

4: Mut tai jos me oltais tätä kuinka pitkään mietitty, tai ainakin mä ehkä, niin en tiiä, mitä tästä ois tullu. ???

But what if we had thought about this longer, or at least, maybe, me, well I don't know what'd have become of this. ???

2: Ok.

Ok.

3: Selevä.

Alright.

(6)

4: Mm, se mitä mä vaan mietin tossa, että jos siellä on enemmän niitä palloja, niin teoriassahan nii se ei kerkeä liikkumaan hirvittävän paljon, että se tota törmää. Aina kun se törmää, niin sen suunta on satunnainen. Mutta mitä enemmän se törmää, niin sitä varmemmalla todennäköisyydellä se niinku vaihtaa suunta Niinkun… Melkein vastakkaiseksi jopa… Et mitä enemmän siel on palloja, niin sitä pienemmällä todennäköisyydellä se pääsee pitkän matkan niinku tossa kuvassa. Et jos sä mietit vaikka, et sulla on vaikka jalkapallo kentällä, sun on paljon helpompi potkasta palloa silleen, et se menee toisesta päästä toiseen päähän, jos siinä on vaikka kahdeksan pelaajaa versus, et siinä ois sata pelaajaa välissä.

Hm, I was just thinking there that if there are more balls, then, in theory, it wouldn't manage to move that much so that it collides. Each time it collides, its direction is random. However, the more it collides the, the more probable it, well, changes direction. I mean…Almost completely opposite. So, the more balls there, the less probable it is for it to travel a great distance as in that picture. So, if we think, for instance, that you have a soccer ball in a field, you have a much easier time kicking the ball there, from one end to the other, if there were like eight players compared to having a hundred players in between.

5: Mm.

Hm.

1: Paitsi jos ?? ei oo mitään merkitystä. [Naurua]

But what if ?? or there is no point. [Laughter]
4: Niin, mut siis niinku, se on niinku se periaate, millä mä niinku tota miettisin. Et se niinku riippuis siitä, et mitä enemmän siellä on tota… hiukkasia, niin sitä pienemmän määrän… tai sitä pienemmän matkan se keskimääräisesti liikkuis. Mutta, it's just me.
Yeah, but I mean it is like the principle which I use to think about it. So, it depends on that, the more there are of those…particles, the smaller the amount…or the shorter the distance it moves on average. But, it's just me.

(10)
4: Miten ois tuo neliöjuurinen, koska sitten ku siinä on se tuhat, nii…
How would that be square rooted, since then there it's a thousand, so...
3: Mä sain tännekin neliöjuurta.
I also got the square root here.
4: Nii, koska se alkaa olemaan 1000, niin senhän pitäis olla teoriassa kymmenen kertaa isompi mitä toi N:n, niin sen pitäis olla noin 90. Niin tota, kyllä väittäsin, että se on neliöjuurellinen. Ja mitä 3 nyt sai tuolta analyyttisesti laskettu Väittäsin neliöjuurellist Mitä sä touhuat (2:lle)?
Yea, because it starts to be 1000, so then, in theory, it should be ten times larger than that N, so it should be around 90. Yeah, so, I would argue that it is square rooted. And what speaker 3 now got calculated from that analysis. I'd argue for square rooted. What are you up to (to speaker 2?)

(11)
3: Nii nythän jos jollain nuista olis eri nopeus, nii sit ne ei jakais sitä toistensa kanssa, että niillä voi olla vaikka täysin eri nopeudet.
Yea, now if any of those were a different speed, then they would not split it with each other, so they could have completely different speeds.
4: Kyllä mä väittäsin, että toi on totta, koska sillohan ne ei tosiaankaan jaa sitä, ja se entropia ei kasva.
I would argue that it is true, since then they do not divide it, and the entropy does grow.
3: Nii, et se… Ne pysyy ominaan…
Yea, so it…They stay on their own…

On the other hand, there were five minor discourses (1, 3, 4, 6, 10, and 11) in which interactees from both groups focused on the order and length of events for a certain "future". These five minor discourses were labeled as "Hypothetical future" and can be found in Table 3.5B.

Table 3.5B Hypothetical future label

(1)
3: Kuvittelis… Siis kuvittelis, että kun jos tämä on summa…
Imagine…Just imagine if this then is the sum...
2: Mm.
Hm.

(5)
4: No mitäs sitten, jos me vaikka lisätään sen N:n määrää, vaikka tuhanteen, niin sehän sitten nostaa sitä törmäysten määrää.
Well, what then, if we, for instance, increased the amount of N to, say, 1000, so that it raises the number of collisions.
2: Nii.
Yea.

(7)
2: Voidaanhan me laittaa vielä enemmän näitä (silmukan kierrosten lkm), ku meillä on nää täällä (yritysten määrä) rajottamassa. Laitetaan tohon tommonen (500 kierrosta), nii kestää tunnin tää ajo, mutta tota.

> *We could then still put more of these (number of cycled loops), since they (number of attempts) are unlimited here. Let's put this here (500 cycles) so it'll last an hour, this run, but, well.*
> 4: Ei se varmaan ihan niin kauan kestä.
> *No, it shouldn't take that long.*
> 2: Ei. Mutta tän ei pitäs muuttuu siltikään tossa.
> *No. But this here still should not be changed.*
>
> (8)
> 4: Laskeekohan se sen niinku koko matkan?
> *Does it calculate the, it's whole distance?*
> 5: Kyl mä väitän, et se muuttu (nyt ka=136).
> *I'd say it'll change (now ka=136).*
> 2: Nii se kyllä muuttu. [Naurua]
> *Yea it'll change. [Laughter]*
>
> (9) H
> 5: Sitä K:ta (silmukan kierrosten lkm) voi varmaan tiputtaa, nii se ei aja niin kauan.
> *That K (number of cycled loops) may probably drop off, so it doesn't run that long.*
> 2: No ei sillä oo merkitystä, ei tää aja kumminkaan niin kaua Tai katotaan, ei toi hirveen kauaa.
> *Well it doesn't serve any point to run this that long either. Or let's see, it won't be super long.*

Despite the fact the number of minor discourses between the two groups was quite similar for Lesson 5: Task 6, the interactees still had a tendency to orient themselves towards a certain present or a certain future, underscoring the observations made in sections 3.2 and 3.3.

Table 3.6 Distribution of minor discourses between groups per label for the third theme of temporality of learning

Label	Group A (L5: T6) Discourses	Group B (L5: T6) Discourses
Hypothetical present	2, 3, 4	6, 10
Hypothetical future	1	5, 7, 8, 9
Total	**4**	**6**

Looking at Table 3.6, out of the 10 discourses in Lesson 5: Task 6, Group A had three minor discourses for "Hypothetical present" and only one for "Hypothetical future" resulting in a total of four minor discourses. Group B had two minor discourses for "Hypothetical present" but four for "Hypothetical future" resulting in a total of six minor discourses. This means that Group B had a slightly higher frequency of creating hypotheticals focusing on a future compared to Group A. As we already saw in sections 3.2 and 3.3, Group A had

focused more on the present whereas Group B had focused more on the future. Thus, the "Hypothetical present" could be considered as a subdivision of the first theme of temporality of learning, and the "Hypothetical future" could be considered as a subdivision of the second theme of temporality of learning.

3.5   Dasein and the nonlinearity of learning

Having answered the first research question of this study, here I will focus on answering the second research question of this study which was:

2. Which, if any, aspect of Dasein is most prevalent in the interpretations identified in RQ1 and how does it supplement the current analysis?

To answer the first half of the question, it was first necessary to determine the total of each aspect within each heuristic theme. As it was explained in section 2.4, each utterance had an aspect of Dasein and DST position layered along with the heuristic themes from section 2.3. The utterances that were moved into each theme of temporality for sections 3.2-3.4 retained their heuristic theme, and, thus, their layered aspect of Dasein or DST position. From here, the total of each heuristic theme was calculated across each theme of temporality. The results are displayed in Figure 3.3 below.

Figure 3.3 Heuristic distribution for each temporal theme
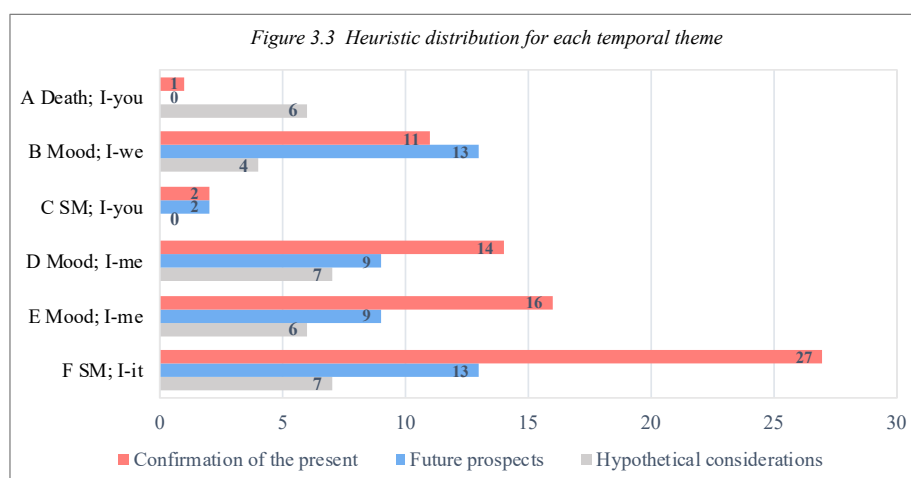
In Figure 3.3, there are three colored lines that represent the three themes of temporality of learning. The red line indicates the *confirmation of the present* theme, the blue line indicates the *future prospects theme*, and the blue line indicates the *hypothetical considerations theme.* The numbers at the ends of each line indicate the total number of utterances for each theme of temporality relative to the heuristic theme. For instance, when looking at the heuristic theme A, the *confirmation of the present* theme had one utterance, the *future prospects theme* had zero utterances, and the *hypothetical considerations theme* had six utterances.

However, Figure 3.3 remains inconclusive since the sense-making and mood aspects of Dasein have been included into more than one heuristic theme. The sense-making aspect of Dasein was layered with C and F, whereas the mood aspect of Dasein was layered with B, D, and E. Thus, the next step was to add the total utterances of all moods (B, D and E) and sense-making (C and F) for each respective theme of temporality. The death aspect of Dasein, however, did not require further action as it was only assigned one heuristic theme (A). This led to the creation of Figure 3.4.

Figure 3.4 Aspects of Dasein for each temporal theme
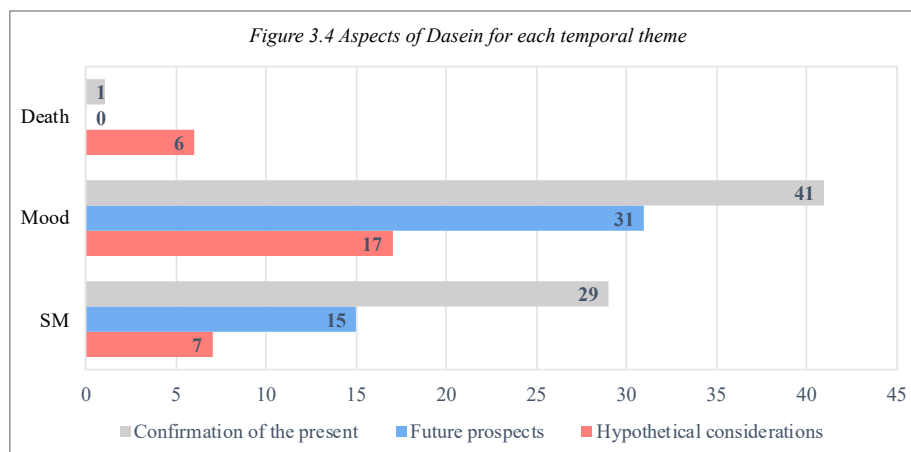
The most prominent aspect of Dasein across all three themes of temporality was Mood, with 41 utterances for the *confirmation of the present* theme, 31 utterances for the *future prospects* theme, and 17 utterances for the *hypothetical considerations* theme. The distribution order of utterances for the mood and sense-making aspects were consistent across the three themes of temporality of learning. First was the *confirmation of the present* theme, second was the *future prospects*

theme, and third was the *hypothetical considerations* theme. The distribution order of utterances for the death aspect of Dasein, however, was different. First was the *hypothetical considerations* theme, then the *confirmation of the present* theme, and lastly the *future prospects* theme.

Having determined the most prevalent aspect of Dasein, we can now approach the second half of the first research question: how does it [the mood aspect of Dasein] supplement the current analysis? Another way to ask this question is to consider what has been answered and what has been unanswered thus far. Through discourse analysis it was possible to identify three themes of temporality in each data set. There was a noticeable difference between the prevalence of each theme of temporality per group for Lesson 5: Task 6. Group A focused on the first theme of temporality, whereas Group B focused on the second theme of temporality. Moreover, Group A focused on the present dimension of hypotheticals, whereas Group B focused on the future dimension of hypotheticals. Through each theme of temporality, it was clear that learning for each group was not linear. What remains unclear is why a non-linear orientation was prevalent for both groups as well as why Group B still managed to achieve the correct answer. This is where the mood aspect of Dasein comes in.

Despite the differences between the features for each theme of temporality of learning, the mood aspect of Dasein was the most apparent in each one when examining at the *utterance level*. This should not be surprising since the fundamental argument of mood states: "in any kind of situation, a person maintains a certain positive or negative mood, whether conscious of it or not, which can reveal, hide, or alter experiences and perceptions of [human] being in relation to Being" (Peltoniemi, in press). Considering the numerous direct and indirect questions made by each group throughout the learning activity, one would think this refers to the sense-making aspect to appear most frequently. However, mood is the *precursor* for sense-making processes because of its omnipresence within beings of Being (Sturgess, 2016). In fact, Heidegger (Trans., 2001) writes: "'A mood makes manifest 'how one is, and how one is faring' ["wie einem ist und wird"]. In this 'how one is', having a mood brings Being to its "there"' (p. 173). Thus, we can understand that the questions made by the

interactees reveal how *inquisitive* they are, and how they are *handling* the complexity of the learning activity.

Moreover, learning is an embodied experience (Koopman & Koopman, 2018). Moods are contained within the mind which is part of the body, and the body has a spatial presence that operates in a *temporal* state. Said differently, temporality is the *vehicle* for Being, and its authentic or inauthentic interpretations are what connects our being with Being for Being to manifest itself to us (Heidegger, Trans., 2001). Of the three aspects of Dasein, mood, particularly verbalized mood, reveals the reciprocal dispositions of those interpreting Dasein. The presence of mood within the three identified themes of temporality underscore the fluctuating and, thus, temporal dispositions of the interactees from both groups.

Table 3.7 "Moods" between Groups A and B		MoodIN	Mood
Confirmation of the present theme	Group A (L5: T6)	7	*8*
	Group B (L5: T6)	*9*	1
	Total	16	9
Future prospects theme	Group A (L5: T6)	2	0
	Group B (L5: T6)	*9*	*12*
	Total	11	12
Hypothetical considerations theme	Group A (L5: T6)	4	2
	Group B (L5: T6)	*6*	*3*
	Total	10	5

As it can be seen in Table 3.7, temporal dispositions were particularly visible within the mood utterances that contained interjections (labeled as MoodIN). Of the total 63 utterances containing mood from both groups for Lesson 5: Task 6 across the three themes of temporality, 37 utterances contained an interjection. The *confirmation of the present* theme had 16 utterances, the *future prospects* theme had 11 utterances, and the *hypothetical considerations* theme had 10 utterances. This coincides with Meinard (2015) who notes that interjections can not only

function as temporal markers, but also as *emotional markers* in everyday discourse. Furthermore, when looking at the distribution of mood with and without interjections, there were notable differences between the groups. Group B not only had 40 of the 63 utterances containing mood, they also had 24 of the 37 utterances containing interjections.

Ultimately, this means that the interactees of Group B were more authentically oriented towards Dasein and, thus, learning itself. Heidegger argued that educational experiences require Dasein to be considered, approached, and synthesized for authentic experiences and interpretations to take form for its learners (Peltoniemi, in press). Since mood is the catalyst for directing sense-making processes, while simultaneously being oriented towards understanding or rejecting death, proactive fluctuations in mood are common and necessary to comprehend the complexity of the physical and temporal spaces in which we find ourselves daily (Shepperd, 2016). Since Group B was proactively communicating their constant grappling of *thrownness* through mood, their sense-making processes seemed to have been more in tuned with themselves and one another.

3.6 DST and the mutual understanding of temporality

In this section, I will focus on answering the third research question of this study which was:

3. Which, if any, *I*-position of DST is most prevalent in the interpretations identified in RQ1 and how does it supplement the current analysis?

Like section 3.5, to answer the first half of the question, it was first necessary to determine the total of each *I*-position within each heuristic theme. The total for each heuristic theme can be found in the same figure as used in section 3.5 (Figure 3.3).

Figure 3.3 Heuristic distribution for each temporal theme
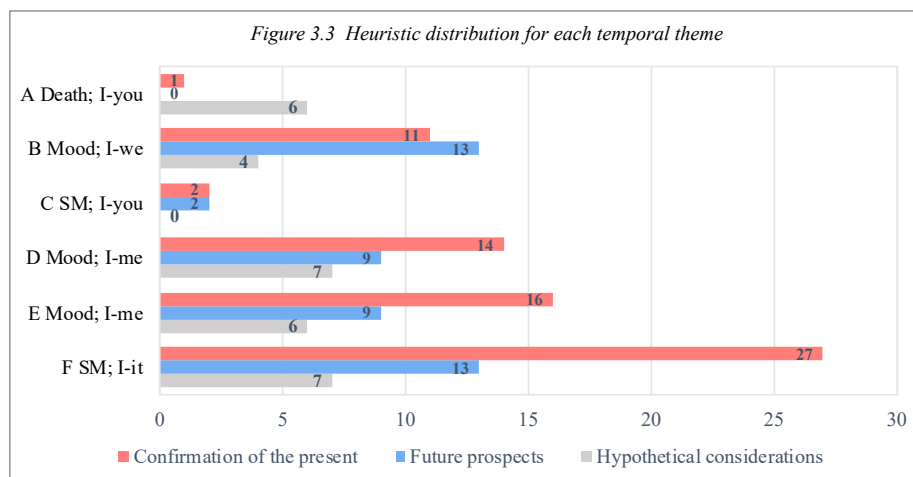
Again, Figure 3.3 does not provide a clear answer because of the overlapping *I*-positions. *I-you* was layered with A and C, and *I-me* was layered with D and E. Thus, the total utterances for *I-you* (A and C) and *I-me* (D and E) for each respective theme of temporality was added. Since *I-we* and *I-it* were only layered with B and F respectively, and they did not require supplemental action. This led to the creation of Figure 3.5.

Figure 3.5 DST positions for each temporal theme
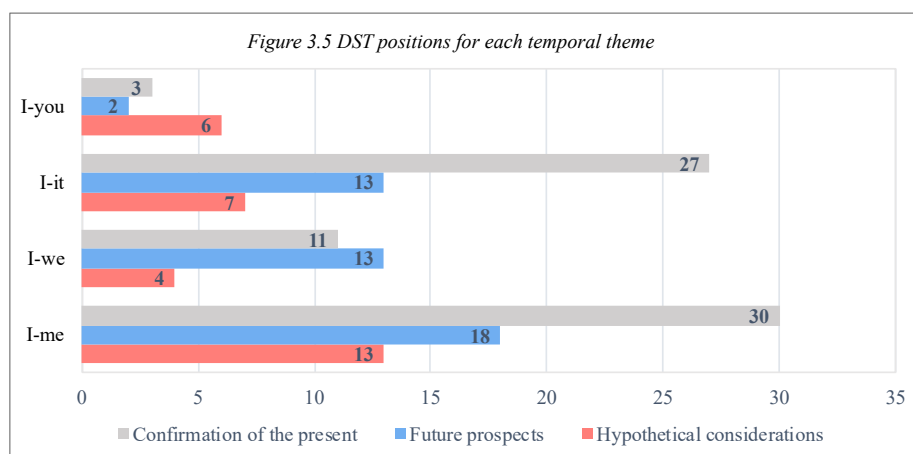
As a result, the most prominent *I-position* of DST across all three themes of temporality was *I-me*, with 30 utterances for the *confirmation of the present* theme, 18 utterances for the *future prospects* theme, and 13 utterances for the *hypothetical considerations* theme. Like the distribution seen in Figure 3.4, except for the *I-you* position of DST, the distribution order of utterances for *I-it, I-we,* and *I-me* positions were consistent across the three themes of temporality of learning in

Figure 3.5. First was the *confirmation of the present* theme, second was the *future prospects* theme, and third was the *hypothetical considerations* theme. Since the *I-you* position had been originally paired with the death aspect of Dasein (see Figure 3.3), its distribution order of utterances remained in parallel fashion with Figure 3.4; first was the *hypothetical considerations* theme, second was the *confirmation of the present* theme, and third was the *future prospects* theme.

Thus, we can now consider the second half of the second research question: how does it [the *I-me* position of DST] supplement the current analysis? Having examined through the lens of Dasein in section 3.5, here I will focus through the lens of DST. Again, despite the differences between the features for each theme of temporality, the *I-me* position of DST was the most apparent when examining at the utterance level. This is not an unexpected result. Of the four *I*-positions (*I-me, I-you, I-we, I-it),* the *I-me* position is the fundamental and most prominent one because the self exists "in a society of mind," by which we compare or consider our various selves together as well as with other entities (Hermans, 2002).

Temporality plays a pivotal role in the communication between these *I*-positions. The compartmentalization of the self in the subjective and objective encounters of *I-you* and *I-it* respectively draw from the present self "I" which has existed before as the past self "me." The contrast of goals or purpose in the *I-we* position also draws from the *I-me* position because the self must first orient itself and its goals before being able to contrast with the *we* goals. The *I-me* position marks the basis of self- and other-relations that develop by drawing from the past or experienced selves. The questions and subsequent affirmative statements made by the interactees demonstrate how each interactee needed to consult the self or others to understand the self, the subjective other (i.e., interactee), or the objective other (i.e., technological learning environment).

One important phenomenon observed that can occur in collaborative-based learning activities is how group cognition becomes an important asset in the learning process (Stahl, 2013). In this study, students worked in small groups of five, allowing each member to participate and negotiate in the learning of the group. However, as Lämsä et al. (2018) noted, the distribution of work and synergy among group members in CSCL is not necessarily equal or distributed

evenly. The utterance distribution among interactees in Table 3.8 below also confirms this tendency.

Table 3.8 Utterances by interactee per theme between Groups A and B		1	2	3	4	5	Total
Confirmation of the present theme	Group A (L5: T6)	2	*16*	7	1	2	**28**
	Group B (L5: T6)	2	*7*	5	4	0	18
Future prospects theme	Group A (L5: T6)	0	1	*2*	0	0	3
	Group B (L5: T6)	3	9	4	*10*	7	**33**
Hypothetical considerations theme	Group A (L5: T6)	*3*	3	3	1	0	10
	Group B (L5: T6)	1	5	1	*7*	3	**17**

In the first theme of temporality of learning, interactee 2 was the dominant one of the five for both Groups, but more so in Group A. In the second theme of temporality of learning, there is not such a distinction. Overall, the interactees of Group A were nearly absent, and the utterances between the interactees of Group B were not lopsided in the same way as seen in Group A in the first theme. In the third theme of temporality of learning, the distribution among interactees of Group A was also not lopsided; however, interactee 4 of Group B had a slightly stronger presence than others.

This imbalance of utterances between interactees can be explained further through DST. Hermans and Gieser (2012) note that the social power relations that exist between people in society may also exist in the *society of the self* "by the simple fact that one participant knows more about a particular topic, has more information available or has more expertise in a particular field than the interaction partner" (p. 21). Interestingly, in the first theme of temporality of learning, of 16 utterances made by interactee 2 of Group A, 10 of them contained the *I-it* position, four of them contained the *I-me* position, two of them contained the *I-we* position, and the *I-you* position was not present at all. The lack of the *I-me* position and strong presence of the *I-it* position underscore that interactee 2 was more preoccupied in the objective encounter with the technological learning environment than the past or experienced self. Moreover, interactee 2

demonstrated greater expertise in handling the learning activity by making, suggesting or confirming modifications made.

4   DISCUSSION

Originally, I had intended to focus on researching scaffolding and second language learning technologies in Finnish elementary schools. However, due to the coronavirus (COVID-19) pandemic that began in November 2019, I was forced to explore other topics that could be used with existing data at the University of Jyväskylä. I became interested in Dasein after reading briefly about it in the article "Retrieving meaning in teacher education: The question of being" by Hostetler et. al (2007). Later, I discovered the dialogical self theory (DST) in the article "Experiences in sense making: Health science students' I-positioning in an online philosophy of science course" by Arvaja (2015). The words "sense making" from the title of the article echoed the discussion of Dasein by Hostetler et. al (2007).

Sense-making is a powerful and relevant term for aspiring researchers such as myself who are increasingly caught in the fluctuating and expanding vortex of ideas, sounds, images, voices, and world-views thanks to advancements in information technology and the Internet. Thus, I was curious to see how Dasein and DST compared to one another at a critical level (e.g., their fundamental concepts) as well as to explore how research would unfold through their simultaneous incorporation. However, given that I am studying educational sciences, I decided to search for an underlying theme which could practically bring together Dasein, DST, and education. This is when the temporality of learning came to mind through several articles (e.g., Lämsä et al., 2018; Lämsä et al., 2020).

Time is a fundamental aspect for learning, and in this study, the interpretation of order and progression of time in collaborative learning in a technological learning environment was explored through discourse analysis. As a result, it was possible to identify three themes or interpretations for understanding temporality in relation to learning. Despite the differences between each theme of temporality, they all relate to the fundamental features of time: 1) time is movement or the absence of it, and 2) time can be perceived through ordering or acknowledging the conceptualized events that form it. While

the linearity of time remains a subject of debate, this study has observed that learning, as a process, is not linear, particularly when using digital learning tools.

The technological learning environment of the students had been pre-designed to present a series of events that required content understanding as well as chronological comprehension from its users, i.e., the students. The students in this study were given the choice to duplicate events or re-enact them through modifying certain variables. The decision-making process marks the relationship between learning and time when reviewing their discourses. In particular, the minor discourses within each theme revealed that the students from both groups retraced (repeated) past events, focused on new (future) outcomes, and postulated new pasts and new futures in mixed fashion. Finally, it also appears that discourse focusing extensively on the real present or a hypothetical one, instead of a future or a hypothetical one, may lead to incorrect conclusions such as Group A in this study.

The three themes of temporality of learning also raised questions on the mindset of students (i.e., human consciousness) while they shifted through *tenses* as well as the dynamics of *interpersonal and intrapersonal relationships*. In this study, the former was addressed by Dasein and the latter by DST. The mood aspect of Dasein highlighted that successfully comprehending and communicating the complexity of the learning activity can be achieved through discourse based on mood as well as mood-based interjections. The *I-me* position of DST highlighted the importance of balancing *retrospective* and *projective* narratives in dialogical communication. It was also observed that group-based cognition may be difficult to establish when the *I-me* position becomes less prevalent to other *I*-positions at a personal level.

5   LIMITATIONS AND RECOMMENDATIONS

Like any ambitious study, perfection is not always guaranteed and further research may still be necessary. Here, I will highlight the main limitations of this study as well as provide recommendations for future researchers.

The first and foremost limitation of this study pertains to Dasein and DST. Wheeler (2020) notes that Dasein has many other features such as care in addition to the three aspects of Dasein that are better understood by reviewing other works in addition to *Being and time*. This study, however, focused on Dasein as discussed in *Being and time* by highlighting its three aspects even though the word "aspect" was never actually used by Heidegger when explaining Dasein. Considering how Heidegger himself did not consider Dasein to be complete in *Being and time*, future researchers may want to conduct a more holistic review of Dasein through examining the other works of Heidegger.

The application method of DST in this study also needs to be considered. While DST has been increasingly applied in fields outside of psychology, it still remains as a developing theory. This means that consensus among researchers varies when its complexity is increased through new interpretations and directions (Suszek, 2017). This study was ambitious in this regard because it attempted to compare and contrast all DST positions at the same time in line with heuristics (e.g., Johnstone, 2018), which had not been done before. Thus, the contents of this research should be re-examined and, perhaps, even discussed in future dialogical self conferences in order to obtain a scholastic review of its potential contribution.

The second limitation of this study is its data. Although the sample size of participants included both genders representing different ages and skill levels, overall, the sample size was small and relatively homogenous in that all students were Finnish and spoke in Finnish. Given the fact that language, in the linguistic sense, is our fundamental repertoire by which we can communicate our thoughts, feelings, and understanding, different languages may allow for different modes of expression. Moreover, while culture as well as its constituents remain complex and debated among scholars (e.g., Reeves-Ellington & Yammarino, 2010), culture

is an important facet of human *nature* (DST) and human *being* (Dasein). Thus, future researchers may want to examine discourses that include different languages and cultures to see how temporality is captured as well as if certain heuristic themes, aspects of Dasein, and DST positions are more evident in one than the other.

The final limitation of this study is the analysis method itself. While discourse analysis is a well-recognized and established research method, its application in this study did not reflect traditional patterns as described by Johnstone (2018). Dasein is an existential-phenomenological approach for conducting profound ontological examinations, and DST is a psychological theory used to conduct dialogic analysis. However, in this study, both were treated as a complementary discoursal undertones within discourse analysis. This leads to complex and, in some cases, contradictory discussions when reviewing Dasein with DST. Thus, future researchers may want to consider applying only one of the two at a time with discourse analysis or other research methods.

6   CONCLUSION

Overall, this study was able to demonstrate that learning is a non-linear process and a uniquely perceived (sub)conscious experience that is better captured through a temporal investigation of the events that comprise the process. This study also highlighted how students may interpret collaborative learning with discussions that focus on the passage of events, the order of events, or the manipulation of passage and/or order of events. However, successful collaborative learning may be better achieved by focusing more on the order of events, even if they are hypothetically formulated, and by mutual understanding through proactive communication. Furthermore, Dasein and DST revealed that effective communication and temporal orientation with oneself and others are achieved through a balanced combination of reason and emotion.

Moreover, the research method in this study successfully demonstrated how temporality in learning sciences can be better understood through a carefully tailored qualitative research method. Specifically, the layering of Dasein and DST in the second phases of analysis was able to capture subtle nuances embedded in everyday discourse that may remain otherwise unnoticed. Nonetheless, Stahl (2013) notes that there are theoretical frameworks other than Dasein and DST that remain untouched in learning sciences research. Thus, future researchers may want to consider using this study as a fundamental guide when layering other theoretical frameworks in the exploration of the temporality of learning.

REFERENCES

Akkerman, S. F., & Van Eijck, M. (2013). Re-theorising the student dialogically across and between boundaries of multiple communities. *British Educational Research Journal, 39*(1), 60–72. https://doi.org/10.1080/01411926.2011.613454

Andrade, A., Danish, J. A., & Maltese, A. V. (2017). A measurement model of gestures in an embodied learning environment: Accounting for temporal dependencies. *Journal of Learning Analytics*, 4(3), 18–46. https://doi.org/10.18608/jla. 2017.43.3

Aristotle. (1992). *Fysiikka* (T. Jatakari & K. Näätsaari, Trans.). Gaudeamus.

Arvaja, M. (2015). Experiences in sense making: Health science students' I-positioning in an online philosophy of science course. *Journal of the Learning Sciences, 24*(1), 137–175. https://doi.org/10.1080/10508406.2014.941465

Bakeman, R., & Gottman, J. M. (1997). *Observing interaction: An introduction to sequential analysis*. Cambridge university press.

Baker, M. (1992). *In other words: A course book on translation*. Routledge.

Bakhtin, M. (1984). Problems of Dostoevsky's poetics (C. Emerson, Trans). In *Theory and History of Literature* (Vol. 8). University of Minnesota Press.

Barresi, J. (2002). *A three dimensional model of the dialogical self, paper presented at the Second International Conference on the Dialogical Self, Ghent, 2002.*

BonJour, L. (2010). *Epistemology: Classic problems and contemporary responses* (2nd ed.). Rowman & Littlefield Publishers.

Bronfenbrenner, U. (1979). *Ecology of human development: Experiments by nature and design*. Harvard University Press.

Bruner, J. (1991). The narrative construction of reality. *Critical Inquiry, 18*(1), 1–21. https://www.jstor.org/stable/1343711

Byrne, D. (2016). *Research ethics*. SAGE Publications, Inc.

Cajori, F. (1926). Origins of fourth dimension concepts. *The American Mathematical Monthly, 33*(8), 397–406. https://www.jstor.org/stable/2298325

Chen, B., Resendes, M., Chai, C. S., & Hong, H.-Y. (2017). Two tales of time: uncovering the significance of sequential patterns among contribution

types in knowledge-building discourse. *Interactive Learning Environments, 25*(2), 162–175. doi: 10.1080/10494820.2016.1276081

Chi, M. T. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of the Learning Sciences*, *6*(3), 271–315.

Collins, J. (2010). *Heidegger ja natsit* (R. Huttunen, J. Tiihonen, J. Kurki, & A. Kirjat, Trans.). Multiprint Oy.

Cooper, M. (2003). "I-I" and "I-Me": Transposing Buber's interpersonal attitudes to the intrapersonal plane. *Journal of Constructivist Psychology, 16*, 131–153. doi: 10.1080/10720530390117911

Cooper-White, P. (2014). Intersubjectivity. In Leeming D.A. (eds), *Encyclopedia of Psychology and Religion*. Springer. https://doi.org/10.1007/978-1-4614-6086-2 _9182

Csanadi, A., Eagan, B., Kollar, I., Shaffer, D. W., & Fischer, F. (2018). When coding-and-counting is not enough: using epistemic network analysis (ENA) to analyze verbal data in CSCL research. *International Journal of Computer-Supported Collaborative Learning*, *13*(4), 419–438. https://doi.org/ 10.1007/s11412-018-9292-z

Dialogical Institute. (2010, March, 17). *Hubert Hermans' summary of the Dialogical Self* [Video]. https://www.youtube.com/watch?v=TKEKWzZOC3I

Driscoll, M. P. (2014). *Psychology of learning for instruction* (3rd ed.). Pearson Education.

Driver, C., Crawford, S., & Stewart, J. (2013). *Being and relating in psychotherapy: Ontology and therapeutic practice*. Palgrave Macmillan.

Fieser, J. (2020). Ethics. In *Internet Encyclopedia of Philosophy (IEP)*. https://iep.utm.edu/ethics/

Fisher, D. & Frey, N. (2011). *The purposeful classroom: How to structure lessons with learning goals in mind*. ASCD.

Gee, J. P. (2010). *An introduction to discourse analysis: Theory and method* (3rd ed.). Routledge.

Gillespie, A., & Cornish, F. (2010). Intersubjectivity: Towards a dialogical analysis. *Journal for the Theory of Social Behaviour*, *40*(1), 19-46. https://doi.org/10.1111/j.1468-5914.2009.00419.x

Goldman, S. R., Braasch, J. L. G., Wiley, J., Graesser, A. C., & Brodowinska, K. (2012). Comprehending and learning from internet sources: Processing patterns of better and poorer learners. *Reading Research Quarterly, 47*(4), 356–381. https://doi.org/10.1002/RRQ.027

Grossen, M., & Orvig, A. (2011). Dialogism and dialogicality in the study of the self. *Culture and Psychology, 17*(4), 491–509. https://doi.org/10.1177/1354067X11418541

Grundmann S., Trabert, D., Fehre K., Strenger, N., Pier, A., Kaiser, L., Kircher, M., Weller, M., Eckart, S., Schmidt, L., Ph. H., Trinter, F., Jahnke, T., Schöffler, M. S., & Dörner, R. (2020). Zeptosecond birth time delay in molecular photoionization. *Science 370*(6514), 339–341. doi: 10.1126/science.abb9318

Günthner, S., & Deppermann, A. (2015). *Temporality in Interaction*. John Benjamins Publishing Company.

Hahnel, C., Goldhammer, F., Naumann, J., & Kröhne, U. (2016). Effects of linear reading, basic computer skills, evaluating online information, and navigation on reading digital text. *Computers in Human Behavior*, *55*(A), 486–500. https://doi.org/10.1016/j.chb.2015.09.042

Haselow, A. (2019). Discourse marker sequences: Insights into the serial order of communicative tasks in real-time turn production. *Journal of Pragmatics, 146*, 1–18. https://doi.org/10.1016/j.pragma.2019.04.003

Haynes, A. (2010). *The complete guide to lesson planning and preparation*. Continuum.

Heidegger, M. (2001). *Being and time* (7th ed.). (J. Macquarrie & E. Robinson, Trans.). Oxford.

Heidegger, M. (2010). *Mitä on metafysiikka?* (A. Salminen, Trans.). Niin & Näin.

Hermans, H. J. M. (2001). The dialogical self: Toward a theory of personal and cultural positioning. *Culture and Psychology, 7*(3), 243–281. https://doi.org/10.1177/1354067X0173001

Hermans, H. J. M. (2008). How to perform research on the basis of dialogical self theory? Introduction to the special issue. *Journal of Constructivist Psychology, 21*, 185–199. doi: 10.1080/10720530802070684

Hermans, H. J. M., & Gieser, T. (2012). *Handbook of dialogical self theory*. Cambridge University Press.

Hermans, H. J. M., & Kempen, H. J. G. (1993). *The dialogical self: Meaning as movement*. Academic Press.

Hermans, H. J. M., Kempen, H. J. G., & van Loon, R. J. P. (1992). The dialogical self: Beyond individualism and rationalism. *American Psychologist, 47*(1), 23–33. doi: 10.1037/0003-066X.47.1.23

Hill, R. K. (1990). Foucault's critique of Heidegger. *Philosophy Today, 34*(4), 334–341.

Hoerl, C. & McCormack, T. (2001). *Time and memory: Issues in philosophy and psychology.* Clarendon Press: Oxford University Press.

Honderich, T. (2005). *The Oxford companion to philosophy*. Oxford University Press.

Horrigan-Kelly, M., Millar, M., & Dowling, M. (2016). Understanding the key tenets of Heidegger's philosophy for interpretive phenomenological research. *International Journal of Qualitative Methods 15*(1), 1–8. https://doi.org/10.1177/ 1609406916680634

Hostetler, K., MacIntyre Latta, M. A., & Sarroub, L. K. (2007). Retrieving meaning in teacher education: The question of being. *Journal of Teacher Education, 58*(3), 231–244. https://doi.org/10.1177/0022487107299977

International Society for Dialogical Science (ISDS). (2020). https://www.dialogicalself. org/

Jacobs, M. (2003). *Sigmund Freud* (2nd ed.). London: SAGE. http://dx.doi.org/10.4135/9781446215128

Jacquette, D. (2002). Ontology. Acumen.

James, W. (1890). *The Principles of Psychology* (Vol 1). Macmillan.

Johnstone, B. (2018). *Discourse analysis* (3rd ed.). Wiley Blackwell.

Jones, P. W. (1998). Globalisation and internationalism: Democratic prospects for world education. *Comparative Education, 34*(2), 143–155. https://doi.org/ 10.1080/03050069828243

Kapur, M. (2011). Temporality matters: Advancing a method for analyzing problem-solving processes in a computer-supported collaborative

environment. *International Journal of Computer-Supported Collaborative Learning, 6*(1), 39–56. https://doi.org/10.1007/ s11412-011-9109-9

Kinchin, I. (2003). Effective teacher student dialogue: A model from biological education. *Journal of Biological Education, 37*(3), 110–113. doi: 10.1080/ 00219266.2003.9655864

Knight, S., Wise, A. F., & Chen, B. (2017). Time for change: Why learning analytics needs temporal analysis. *Journal of Learning Analytics*, 4(3), 7–17. https://doi.org/10.18608/jla.2017.43.2

Koopman, O., & Koopman, K. J. (2018). The body as blind spot: Towards lived experience and a body-specific philosophy in education. *Education as Change, 22*(3). https://doi.org/10.25159/1947-9417/1880

Kotimaisten kielten keskus. (2015). Aikamuotoja: Tuleva aika (vie, veisi, vienee). http://www.kielitoimistonohjepankki.fi/haku/adverbit/ohje/657

Lockwood, M. (2005). *The labyrinth of time: Introducing the universe*. Oxford University Press.

Lund, K., Quignard, M., & Williamson Shaffer, D. (2017). Gaining insight by transforming between temporal representations of human interaction. *Journal of Learning Analytics*, 4(3), 102–122. http://dx.doi.org/ 10.18608/jla.2017.43.6

Lämsä, J., Hämäläinen, R., Koskinen, P., & Viiri, J. (2018). Visualising the temporal aspects of collaborative inquiry-based learning processes in technology-enhanced physics learning. *International Journal of Science Education, 40*(14), 1697–1717. https://doi.org/10.1080/09500693.2018. 1506594

Lämsä, J., Hämäläinen, R., Koskinen, P., Viiri, J., & Lampi, E. (2021). What do we do when we analyse the temporal aspects of computer-supported collaborative learning ? A systematic literature review. *Educational Research Review 33*(100387), 1–20. https://doi.org/10.1016/j.edurev.2021.100387

Lämsä, J., Hämäläinen, R., Koskinen, P., Viiri, J., & Mannonen, J. (2020). The potential of temporal analysis: Combining log data and lag sequential analysis to investigate temporal differences between scaffolded and non-

scaffolded group inquiry-based learning processes. *Computers & Education, 143*, 103674. https://doi.org/10.1016/j.compedu.2019.103674

Löfgren, K. (2013, February 15). *What is ontology? Introduction to the word and the concept* [Video]. https://www.youtube.com/watch?v=XTsaZWzVJ4c

Löfgren, K. (2013, February 23). *What is epistemology? Introduction to the word and the concept* [Video]. https://www.youtube.com/watch?v=lI9-YgSzsEQ

Markosian, N. (2016). Time. In E. N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*. https://plato.stanford.edu/archives/fall2016/entries/time/

May, R. & Parkes, G. (1996). *Heidegger's hidden sources: East Asian influences on his work*. Routledge.

Mead, G. H., & Morris, C. W. (1934). *Mind, self, and society from the standpoint of a social behaviorist*. University of Chicago Press.

Meinard, M. E. M. (2015). Distinguishing onomatopoeias from interjections. *Journal of Pragmatics, 76*, 150–168. https://doi.org/10.1016/j.pragma.2014.11.011

Mercer, N. (2008). The seeds of time: Why classroom dialogue needs a temporal analysis. *Journal of the Learning Sciences, 17*(1), 33–59. doi: 10.1080/10508400701793182

Moon, K., & Blackman, D. (2014). A guide to understanding social science research for natural scientists. *Conservation Biology, 28*(5), 1167–1177. https://doi.org/10.1111/cobi.12326

Mumford, J. (2013). To arrive where we started, and know the place for the first time: Heidegger, phenomenology, the way human beings first appear in the world, and fresh perspectives on the abortion debate. *New Bioethics, 19*(2), 72–83. https://doi.org/10.1179/2050287713Z. 00000000029

Naya, Y., & Suzuki, W. A. (2011). Integrating what and when across the primate medial temporal lobe. *Science, 333*(6043), 773–776. https://doi.org/10.1126/science. 1206773

Niemi, J., Nenonen, M., Penttilä, E., & Riionheimo, H. (1998). Is the order of adverbs predictable on lexical grounds? In *SKY 1998: The 1998 Yearbook of the Linguistic Association of Finland* (pp. 127–139). http://www.linguistics.

fi/julkaisut/SKY1998/SKY_JoL_1998_07_is_the_order_of_adverbs_predic table_on_lexical_grounds.pdf

Nuyen, A. (1990). Some Heideggerian reflections on euthanasia. *Metaphilosophy, 21*(1/2), 133–140. http://www.jstor.org/stable/24436760

Oinas, Z. (2011). *Guide to Finnish verbs* (3rd ed.). Finnlibri.

Ott, B. L. & Mack, R. L. (2014). *Critical media studies: An introduction* (2nd ed.). John Wiley & Sons, Incorporated.

PHILO-notes. (2018, June 11). *What is Ethics? – PHILO-notes Whiteboard Edition* [Video]. https://www.youtube.com/watch?v=Rr7U49RPpTs

Pihlström, S., Siitonen, A., & Vilkko, R. (2000). *Aika*. Gaudeamus.

Prosser, S. (2016). *Experiencing time* (1st ed.). Oxford University Press. doi: 10.1093/acprof:oso/9780198748946.001.0001

Quinton, S. & Reynolds, N. (2018). Temporality in digital research. In *Understanding research in the digital age* (pp. 89–114). SAGE Publications Ltd. https://www.doi.org/10.4135/9781529716573

Raggatt, P. T. F. (2015). Positioning: Dialogical voice in mind and culture. *Theory & Psychology, 25*(6), 775–797. doi: 10.1177/0959354315590850

Reeves-Ellington, R. H. & Yammarino, F. J. (2010). *What is culture? Generating and applying cultural knowledge*. Edwin Mellen Press.

Rescher, N. (2003). *Epistemology: An introduction to the theory of knowledge*. State University of New York.

Riemer, K., & Johnston, R. B. (2014). Rethinking the place of the artefact in IS using heidegger's analysis of equipment. *European Journal of Information Systems, 23*(3), 273-288. doi: http://dx.doi.org/10.1057/ejis.2013.5

Ritson, S., & Camilleri, K. (2015). Contested boundaries: The string theory debates and ideologies of science. *Perspectives on Science, 23*(2), 192–227. https://doi.org/10.1162/ POSC_a_00168

Rockmore, T. (2003). Dilthey and historical reason. *Revue Internationale de Philosophie, 57*(226), 477–494. https://www.jstor.org /stable/23955847

Rudman, R., & Bruwer, R. (2016). Defining web 3.0: Opportunities and challenges. *The Electronic Library, 34*(1), 132–154. https://doi.org/10.1108/ EL-08-2014-0140

Sahlberg, P. (2004). Teaching and globalization. *Managing Global Transitions, 2*(1), 65–83.

Saint, J., Gašević, D., Matcha, W., Uzir, N. A. A., & Pardo, A. (2020, March). Combining analytic methods to unlock sequential and temporal patterns of self-regulated learning. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge* (pp. 402-411).

Shepperd, J. (2016). Heidegger on transforming the circumspect activity of spatial thought. *Educational Philosophy and Theory, 48*(8), 752–763. https://doi.org/10.1080/ 00131857.2016.1165011

Smith, J. F. (1973). A Critique of Martin Heidegger. *The Southwestern Journal of Philosophy, Fall, 4*(3), 137–156. https://www.jstor.org/stable/43154953

Smolin, L. (2007). *The trouble with physics: The rise of string theory, the fall of a science, and what comes next.* Houghton Mifflin.

Soller, A., Wiebe, J., & Lesgold, A. (2002). A machine learning approach to assessing knowledge sharing during collaborative learning activities. In G. Stahl (Ed.), *Proceedings of Computer Support for Collaborative Learning* (pp. 128–137). Erlbaum. doi: 10.3115/1658616.1658635

Spencer-Rodgers, J., Boucher, H. C., Mori, S. C., Lei Wang, & Kaiping Peng. (2009). The dialectical self-concept: Contradiction, change, and holism in East Asian cultures. *Personality and Social Psychology Bulletin, 35*(1), 29–44. https://doi.org/10.1177/ 0146167208325772

Stahl, G. (2013). Theories of collaborative cognition: Foundations for CSCL and CSCW together. In Goggins S., Jahnke I., Wulf V. (Ed.), *Computer-Supported Collaborative Learning at the Workplace* (Vol. 14, pp. 1–20). Springer. https://doi.org/10.1007/978-1-4614-1740-8_3

Stamelman, R. (1987). The Dialogue of Absence. In *Studies in 20th & 21st Century Literature, 12*(1), 10 (pp. 93–113). https://newprairiepress.org/cgi/ viewcontent.cgi?article= 1210&context=sttcl

Steger, M. B. (2003). *Globalization: A very short introduction.* Oxford University Press.

Sturgess, J. (2016). Drawing from Heidegger: Dasein and the question of communication. *Empedocles: European Journal for the Philosophy of Communication, 7*(1), 23-37. doi: 10.1386/ejpc.7.1.23_1

Sullivan, P. (2012). *Introducing dialogue to qualitative analysis.* SAGE Publications, Inc. doi: 10.4135/9781446268391

Suszek, H. (2017). Critique of dialogical self theory. In *Advances in Psychology Research* (Vol. 131, pp. 97–138). Nove Sciences Inc. https://www.researchgate.net/publication/324168743_Critique_of_Dialogical_Self_Theory

Suter, W. N. (2012). *Introduction to educational research: A critical thinking approach.* SAGE Publications, Inc. doi: 10.4135/9781483384443

Taylor & Francis Books. (2017, July 17). *What is Dasein?* [Video]. https://www.youtube.com/ watch?v=2BSeS7mWwRg

Temporal, adj.1 and n.1. (2020). In *OED Online.* Oxford University Press. www.oed.com/view/Entry/198943

Tracy, S. J. (2012). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact.* Oxford.

Tsang, N. M. (2007). Reflection as dialogue. *British Journal of Social Work, 37*(4), 681–694. https://doi.org/10.1093/bjsw/bch304

Van Gulick, R. (2018). Consciousness. In E. N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy.* https://plato.stanford.edu/archives/spr2018/ entries/consciousness/

Van Leeuwen, A., Janssen, J., Erkens, G., & Brekelmans, M. (2013). Teacher interventions in a synchronous, co-located CSCL setting: Analyzing focus, means, and temporality. *Computers in Human Behavior, 29*(4), 1377–1386. https://doi.org/10.1016/j.chb. 2013.01.028

Wegerif, R. (2008). Dialogic or dialectic? The significance of ontological assumptions in research on educational dialogue. *British Educational Research Journal, 34*(3), 347–361. https://doi.org/10.1080/0141192070 1532228

Wetherell, M., & Potter, J. (1988). Discourse analysis and the identification of interpretative repertoire. In C. Antaki (Ed.), *Analysing everyday explanation: A casebook of methods*. SAGE Publications, Inc.

Wheeler, M. (2020). Martin Heidegger. In E. N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*. https://plato.stanford.edu/archives/fall2020/entries/heidegger/

Willig, C. (2014). Discourses and discourse analysis. In *Flick, U. The SAGE handbook of qualitative data analysis* (pp. 341–353). SAGE Publications, Inc. doi: 10.4135/9781446282243

Wolin, R. & Naess, A. D. (2020). Martin Heidegger. In *Encyclopedia Britannica*. https://www.britannica.com/biography/Martin-Heidegger-German-philosopher

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

Wood, L. A., & Kroger, R. O. (2000). *Doing discourse analysis: Methods for studying action in talk and text*. SAGE Publications, Inc. doi: http://dx.doi.org/10.4135/9781452233291

鈴木智子, & 阿久津聡. (2012) 消費行動に対する文化的自己観の影響に対する考察: 弁 証法的自己観に着目して (特集 流通の潮流変化). *季刊マーケティングジャーナル, 31*(1), 75–87. http://hdl.handle.net/2433/175280

ATTACHMENTS

1.0 Search results (as of February, 2021) as discussed in the Introduction

Name of website or database	URL of website or database	Keywords used in search bar	Number of displayed results	Number of results relevant to study
Google Scholar	https://scholar.google.com	1) "CSCW" "dialogical self" temporality" "learning"	3	0
		2) "CSCL" "dialogical self" temporality" "learning"	3	0
		3) "CIBL" "dialogical self" temporality" "learning"	0	0
		1) "CSCW" "dasein" temporality" "learning"	26	4
		2) "CSCL" "dasein" temporality" "learning"	14	4
		3) "CIBL" "dasein" temporality" "learning"	0	0
JYKDOK: International e-materials search	https://jyu.finna.fi/Primo/Home	1) "CSCW" "dialogical self" temporality" "learning"	0	0
		2) "CSCL" "dialogical self" temporality" "learning"	1	0
		3) "CIBL" "dialogical self" temporality" "learning"	0	0
		1) "CSCW" "dasein" temporality" "learning"	3	1
		2) "CSCL" "dasein" temporality" "learning"	0	0
		3) "CIBL" "dasein" temporality" "learning"	0	0
ERIC (Education Resources Information Center)	https://eric.ed.gov	1) "CSCW" "dialogical self" temporality" "learning"	0	0
		2) "CSCL" "dialogical self" temporality" "learning"	2	2
		3) "CIBL" "dialogical self" temporality" "learning"	0	0
		1) "CSCW" "dasein" temporality" "learning"	0	0
		2) "CSCL" "dasein" temporality" "learning"	2	2
		3) "CIBL" "dasein" temporality" "learning"	0	0

Website/Database	URL of website or database	Keywords used in search bar	Number of displayed results	Number of results relevant to study
International Journal of Computer-Supported	https://link.springer.com/journal/11412/volumes-and-issues	1) "dialogical self" temporality" "learning"	0	0
		2) "dasein" temporality" "learning"	0	0
The Journal of Collaborative Computing and Work Practices	https://link.springer.com/journal/10606/volumes-and-issues	1) "dialogical self" temporality" "learning"	0	0
		2) "dasein" temporality" "learning"	0	0
Interntional Journal of Science Education	https://www.tandfonline.com/loi/tsed20	1) "dialogical self" temporality" "learning"	0	0
		2) "dasein" temporality" "learning"	1	1
University of Jyväskylä: JYX-julkaisuarkisto	https://jyx.jyu.fi/handle/123456789/25571?	1) "dialogical self" temporality" "learning"	23	2
		2) "dasein" temporality" "learning"	44	2
		Total:	122	18

*Relevancy here is defined as containing three or more of the search keywords in the body of the text and not in the references

2.0 Layering logic as discussed in section 2.4

Theme (Dasein aspect/DST position)	Fundamental traits
A World (Death; *I-you*)	Remarks of reality itself
B Purpose (Mood; *I-we*)	Questions, suggestions, confirmations
C Linguistic structure (SM; *I-you*)	Linguistic structure of utterance matches
D Participants (Mood; *I-me*)	Interjections; topic shifts, concludes
E Discourse-discourse (Mood; *I-me*)	Topic continues or expands
F Media (SM; *I-it*)	Media as the point of interest in the utterance

2.1 Finnish grammar as discussed in section 2.5

Tense	Finnish	English
Present	Minä kerron.	*I tell.*
Past	Me emme kertoneet.	*We did not tell.*
Perfect	Sinä olet kertonut.	*You have told.*
Pluperfect	He olivat kertoneet.	*They had told.*

Adverb	English
nyt	*now*
usein	*often*
koskaan	*never*
aina	*always*
joskus	*sometimes*

Form	Finnish	English (literal)
V1 (present) + temporal adverb	Minä lähden kotiin pian.	*I go home soon.*
V1 (present) + V2 (third infinitive)	Hän menee syomään luonasta.	*He/she goes to eat lunch.*
V1 (conditional form)	Minä haluaisin sitä.	*I would want that.*
V1 (potential form)	Hän saanee lahjaa.	*He/she may receive a gift.*
olla + V1 (present participle)	Totuus on tekevä teidät vapaiksi.	*The truth is to make you free.*