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"Indulge in a Little Chaos": Assistant Language Teachers' Cognition and Pedagogical Knowledge Development Through the Lens of Complex Dynamic System Theory

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Abstract

Teacher cognition has been a major topic of interest in applied linguistics as researchers have worked toward "better understanding the fullness of the work of teaching, a fullness that has proved complex and problematic" (Burns et al., 2015, p. 585). This qualitative study draws upon participant interview data in order to analyze and understand language teacher cognition and pedagogical knowledge development of an under-represented cohort—foreign assistant language teachers (ALTs) in Japan. Participants (n=35) were current or former ALTs with 1 to 19 years of experience working as team teachers in Japan. Interview data was transcribed and coded according to six common features of complex dynamic systems: initial condition, unpredictability, nested structure, non-hierarchic networks, feedback loops, and self-organization (Kiss, 2012). Findings show that ALTs' ability to acquire and operationalize pedagogical knowledge is highly dependent on the maneuver that they must undergo in working within the local Japanese contexts—as opposed to those in their home countries—and in relation to their colleagues who have a variety of individual traits, pedagogical beliefs, and team-teaching practices. This article serves as evidence that language teacher cognition regarding pedagogical knowledge development can be aptly understood through the lens of complex systems theory.

Keywords: Assistant language teachers, cognition, complex dynamic system theory, pedagogical knowledge development

For several decades, teacher thinking, or teacher cognition, has been an influential research area in applied linguistics (e.g., Borg, 2003; Clark & Peterson, 1986; Kubanyiova & Feryok, 2015). Researchers have worked toward "better understanding the fullness of the work of

teaching, a fullness that has proved complex and problematic" (Burns et al., 2015, p. 585). Today, language teacher cognition research pushes the field of applied linguistics forward in new and exciting ways, as it focuses on the unobservable dimension of language teachers' professional lives (Borg, 2019). The current study examines teacher cognition regarding pedagogical knowledge development of an under-represented cohort in language teacher cognition research—foreign assistant language teachers (ALTs) in Japan.

There is now a burgeoning number of team-teaching pairings in EFL settings globally—generally one teacher a local teacher of English, and the other, a foreign-born native English speaker. Japan, too, has sought native speakers of English and ALTs have been stationed alongside Japanese teachers of English (JTEs) in public and private schools at various levels since the 1980's (Hiratsuka, 2022). Most ALTs in Japan are from English-speaking home countries. They generally speak English as their first language, and as ALTs it is their duty to team teach English as a Foreign Language classes across the country (CLAIR, 2022). ALTs in Japan are not specifically required to have obtained qualifications and/or experience in language teaching before employment starts, although their JTE counterparts are credited, licensed teachers (Hiratsuka, 2022). A complex system of dynamics exists between these two parties as a result of the particular characteristics of their different professional and cultural backgrounds. In one example of such a dynamic, the authority of the non-native English-speaking JTE can be undermined—linguistically—by the presence of this native English-speaking ALT in team-taught lessons. Likewise, ALTs in Japan often have little or no Japanese language abilities (i.e., their students' L1), positioning them in a weakened state as professional language instructors within their schools (Hiratsuka, 2017). These idiosyncratic power-dynamics of the team-teaching pair have not been sufficiently investigated, although there is evidence that ALTs' cognition is greatly affected by team-teaching classroom dynamics and by the broader sociocultural contexts (e.g., Miyazato, 2009). For example, as ALTs are contractual short-term teaching assistants, this can put them in a politically weak position in terms of their ability to influence classroom decisions or in regard to the overall direction of the English curriculum. This situation has the potential to cause ALTs to think negatively about the importance of their jobs, resulting in negative emotions such as frustration or disappointment.

Another area of tension can be seen in conflicting ideas concerning teaching styles. Regarding team teachers' educational and cultural backgrounds, ALTs in Japan are often products of the constructivist educational systems of the western liberal tradition. This is an educational culture that values and emphasizes individual achievement, and as a core value it is a perspective where knowledge is believed to be co-constructed by students and teachers in the classroom through interaction (Noddings, 2007). Despite some attempts to mirror western education in policy, the dominant Japanese culture of learning has largely remained steeped in the centuries-old Confucian tradition, prioritizing respect for authority and valuing the development of the group over that of the individual (see Huang & Brown, 2009; Wen & Clément, 2003). Here, teachers are regarded as the possessors of knowledge, and many educators within this paradigm perceive their professional task to be the transference of that knowledge to the students through one-way classroom instruction, creating a culture of learning where lecture-based classes have historically dominated class time (at least to a greater extent than contemporary western classroom counterparts). The mixing of ALTs and JTEs in team-taught English classes in Japan—each carrying distinct assumptions about education—has the potential to produce moments of friction. According to Kato (2001), "since teachers who are from overseas have

little or no experience of being a student within the host culture, the culture they bring into classrooms is likely to be based on their own classroom experience" (p. 54). The current study zeros in on this unique educational situation where team teachers' language learning histories, legitimacy as language teachers, and cultures of learning can potentially clash. In particular, this study focuses on ALT teacher cognition in relation to pedagogical knowledge development. This is done as ALTs, in their unpredictable and unstandardized professional and personal circumstances, are left to "*indulge in a little chaos"* in their journey to learn about their place in a new educational environment, and as they struggle to develop positive teacher identities and become competent language team teachers in Japan.

Theoretical Framework

In studying the language-teaching mind, research has evolved through various ontological generations over the last 30 years (Burns et al., 2015). Beginning with an individualist ontology (appx. 1990; e.g., Johnson, 1992), research in the field moved to social ontology (appx. 1995; e.g., Numrich, 1996), to sociohistorical ontology (appx. 2000; e.g., Breen et al., 2001), and most recently to the complex, chaotic systems ontology (from 2010 onward; e.g., Kiss, 2012). The current study is grounded in the contemporary complex dynamic systems theory. Complex dynamic systems are fluctuating and emerge organically through the interaction of multiple interconnected elements. Attributes of the complex dynamic systems theory include "ecology, emergentism, dynamism, change, unpredictability, interconnectedness, and nonlinearity" that confront "a notion of fixedness and codification in language description and acquisition and their evolutionary trajectories over time" (Burns et al., 2015, p. 593). Drawing from research studies that addressed such complex systems (e.g., Clarke & Collins, 2007; Cochran-Smith, 2003; Davis & Sumara, 2007; Mamchur & Apps, 2009), Kiss (2012) summarized the complex dynamic systems conceptual framework as commonly comprising six distinct features: "(i) sensitivity to initial condition; (ii) unpredictability; (iii) having a nested structure; (iv) showing a non-hierarchic network system; (v) making use of feedback loops; and (vi) emergence of self-organization" (p. 18). In conclusion, Kiss (2012) argued that teacher learning is subject to these six features and that teacher cognition can be discerned from the perspective of each individual feature. Kiss' (2012) study is not free from scrutiny, as it was pioneering and experimental, but as it provides an innovative structure for viewing the complex nature of language teaching, we judged it to be appropriate theoretical framework for the current study, even though the cohort of participants is quite different from Kiss' (2012) article. In the present study, we demonstrate how teacher cognition and the pedagogical knowledge development of ALTs in Japan can be understood via the complex dynamic systems ontology, specifically when viewed from the vantage point of Kiss' (2012) six features of complex dynamic systems.

Teacher Cognition and Pedagogical Knowledge Development

Different teaching methods and approaches require an instructor to perform different levels of cognitive work (Freeman, 2016). For example, methods that focus primarily on rigid drilling exercises (i.e., the audiolingual method) demand less cognitive work by the teacher when compared to more student-centered methods like communicative language teaching (CLT) (see Brandl, 2008). As CLT calls for high levels of interaction, the teacher must constantly assess students' understanding, deliberate when problems arise, and make and implement decisions in real-time in the classroom. In other words, an effective teacher needs to put a lot of cognitive effort into planning and executing successful lesson plans within student-centered environments, as human learning is "a dynamic social activity that is situated in the physical

and social contexts, and is distributed across persons, tools and activities" (Johnson, 2009, p. 1). It is worth investigating when a teacher chooses to implement a particular teaching method in the classroom. They are guided by their personal beliefs and preferred paradigms: when a teacher chooses to adopt a constructivist approach (e.g., CLT), rather than a more Confucian approach (i.e., an approach based on explicit instruction, drilling, or rote memorization), there must be some undercurrent of personal belief dictating this decision. Burns et al. (2015) argue that since a teacher must often decide how to teach on their own, "there must be some cognitive capacity governing those choices and decisions" (p. 587). This line of research is worthy of pursuing with under-represented cohorts in unique sociocultural contexts, such as team-teaching scenarios in Japan.

The current study seeks to explore teacher cognition and the ways in which ALTs acquire pedagogical knowledge as novice language teachers in an educational environment that is new and unknown to them. There are several noteworthy factors that contribute to ALTs' cognition about teaching and their pedagogical knowledge development process. First, in many cases in Japan, ALTs have very little prior teacher training or experience, and some ALTs have never learned a second language as students themselves (Hiratsuka, 2022). These ALTs are therefore likely to be unaware of the students' experiences, needs, and abilities in language learning. Second, ALTs are living in a new culture that is oftentimes exotic to them, and working in an educational environment that is foreign and unfamiliar. As mentioned, ALTs carry a myriad of assumptions and beliefs about education from their home countries that are not necessarily shared by their co-teachers or the broader educational settings in Japan. As a further complication, ALTs usually work with many different JTEs—ranging from 5 to 20 (or more)—each with their own preferred educational beliefs and practices (Hiratsuka, 2022). For the ALT who is just beginning their career, one of their primary tasks is to learn about all of their JTEs and their preferred teaching philosophies and abilities, and to consider how they can best fit into those micro-cultures of learning in order to best support the students' language education (Hiratsuka, 2022). Becoming a successful team teacher, then, hinges largely on the ALT's level of situational awareness, social skills, and emotional intelligence. These are all identity traits that are not easily evaluated during the ALT hiring interviews or placement processes.

For the teaching professional, the act of teaching is both a public and private endeavor (Burns et al., 2015). In research within applied linguistics, the public nature of teaching can be accessed by the researcher through empirical observation (e.g., observing classroom activity, common routines, and interactions). On the other hand, the burden of teaching is also held privately by the teacher when he/she engages in the cognitive work of lesson planning, making classroom decisions, reacting to students, or modifying instruction on-the-spot. In a sense, the private aspect of language teaching can be more challenging for the researcher to access than empirical observation. Therefore, there is a need for qualitative studies, like the present one, that attempt to uncover and elucidate the nuanced nature of language teacher cognition, especially in under-studied cohorts such as ALTs in Japan. It has been established in the literature that: (a) teachers are informed decision makers (Stevick, 1976), (b) teacher cognition and pedagogical knowledge development are affected by their past experiences, educational background, and cultural values (Tajeddin & mi, 2019), (c) teacher cognition and pedagogical knowledge development are tied to, and intertwined with, their social environments (Burns et al., 2015), and (d) teachers' own awareness about their teacher cognition is crucial for effective teaching and professional growth (Farrell & Guz, 2019). The current study seeks greater understanding in these areas through interwoven stories told by 35 ALTs, particularly

concerning their pedagogical knowledge development in Japan as they have navigated their careers as team teachers.

Research Questions

This qualitative study attempted to explore and answer the following research questions:

1. How do ALTs, as novice educators in Japan, learn to teach?
2. To what extent can a complex dynamic systems theoretical approach be used to gain insight to ALTs' cognition and pedagogical knowledge development?

Methods

Participants

ALT contracts in Japan are generally limited to 5 years, though recently they have been extended due to the Covid-19 pandemic. Data in this study derives from a pool of individual interviews with 13 current and 22 former Japan Exchange and Teaching (JET) Program (see CLAIR, 2022) ALT participants (see detailed participant profiles in Appendix A). All participants worked as ALTs in Japan between 1994 and 2021. Due to the fact that there are very few ALTs in Japan from some counties (e.g., Peru, Trinidad and Tobago, etc.), the exact years that the participants worked as ALTs are not specified here, as this could result in revealing their personal identities. M and F participants in the study ranged from 22 to 51 years old (mean age=34.1 years old), and they originated from 12 countries (e.g., the United States, The United Kingdom, Canada, Australia, and New Zealand) with a variety of academic backgrounds (e.g., biology, business, finance, international development, liberal arts, linguistics, psychology, and sociology). At the time of the interviews, the former ALT participants held various jobs (e.g., embassy staff, counselor, medical recruiter, architect, and elementary school teacher). Participants had 1 to 19 years of experience working as team teachers in Japan (3.7 years on average) and had taught in schools ranging from elementary to senior high school throughout the country (some participants continued working as ALTs for many years in other capacities, after their initial 5-year JET Program term and contracts had expired).

Data Collection and Analysis

Participants were recruited using researchers' personal connections and ALT groups on popular social media platforms. After obtaining informed consent, participants were invited to participate in a semi-structured interview. The interview aimed at exploring the participants' learning-to-teach process as they reflected on their experiences as ALTs in Japan. Participants were asked to describe their personal and educational backgrounds, their working conditions as ALTs, and how they felt their skills as language teachers developed over time. Recorded interviews were conducted once, lasting around 90 minutes. Interviews were transcribed and subjected to content analysis (Bogdan & Biklen, 2016). In the present study, significant items and events were coded according to Kiss' (2012) six categories: "(i) sensitivity to initial condition, (ii) unpredictability, (iii) having a nested structure, (iv) showing a non-hierarchic network system, (v) making use of feedback loops, and (vi) emergence of self-organization" (p. 18). In the coding process the following abbreviations were used, which corresponded to Kiss' (2021) six categories: INITIAL, UNPRED, NESTED, NON-H, F-LOOP, and SELF-O. In the first step of the data analysis, transcripts were read by each researcher individually in

qualitative intercoding—a process by which more than one researcher codes the raw data independently. After the first individual reading was completed, the researchers then re-read the transcripts and double checked their own notes to make sure that significant events or elements of the data were not mis-coded. Next the researchers met to compare notes and discuss discrepancies. Once a consensus was met they analyzed the data and organized the findings. In practice, the process of data analysis involved the use of both deductive (driven by research questions and pertinent literature (e.g., Kiss, 2012)) and inductive (driven by gathered data and ongoing data grouping and coding) approaches. These multiple iterations among the data, relevant literature, and research questions, as well as careful consideration to the types and characteristics of data within and across individual cases, helped us to confirm/disconfirm and interpret/re-interpret data patterns and interconnections.

Results and Discussion

Kiss (2012) summarized the complex dynamic systems' conceptual framework as comprising of six features (i.e., initial conditions, unpredictability, nested structure, non-hierarchal network system, feedback loops, and self-organization). Data in the present study was coded and analyzed according to these features in order to explore the ways in which ALTs acquire pedagogical knowledge in team-teaching arrangements in Japan. Viewed from the perspective of Kiss' (2012) six features of complex dynamic systems, the following stories and episodes can be regarded as a window into language teacher cognition in the learning-to-teach process for ALTs in Japan.

Feature (i): Sensitivity to Initial Conditions

Edward Lorenz was one of the first scientists to describe complex systems in an effort to model weather systems. One discovery in this research was that complex systems are extremely sensitive to initial conditions—a small change in the initial conditions of a scientific model could lead to drastic and unpredictable patterns later on (Lorenz, 1969). Initial conditions in teaching environments are also very important as influential features in a complex system.

For ALTs who are just beginning, the initial conditions of their careers may include: prior language teaching knowledge and experience; experience as second language learners themselves; awareness of local language and culture; and first impressions with JTEs and students. Interviews reved the extent to which the learning-to-teach process for ALTs is susceptible to the initial conditions of complex dynamic systems. Some ALTs came into the ALT position with extensive teaching knowledge and experience. Participants 3 and 6 had bachelor's degrees in English linguistics and a TEFL certificate, while participants 14 and 15 both had a master's degree in TESOL. Participants 5 and 28 had previously tutored English for foreign university students for more than 3 years, and participants 7, 10, 13, and 27 had taught English abroad in other capacities. Participant 8 had a degree in special needs education, and participant 23 had a degree in elementary education—both claimed that the qualifications helped them at various junctures as ALTs in Japan. All of these participants came into the ALT position with at least a basic toolbox of language teaching ideas and pedagogical knowledge. These initial conditions no doubt lessened the ALTs' cognitive load in overcoming the learning curve of team teaching in Japan.

In contrast, many ALTs came to Japan with little or no prior teacher training or experience. This situation necessitates a heavier cognitive load during the initial stages of their language teaching career. For these ALTs, transitioning from their previous lives and careers to that of

an ALT can be filled with struggle and hardship. Upon arrival in Japan, most ALTs in the JET Program are given three days of orientation and training in Tokyo before they depart for their individual placement cities and schools (CLAIR, 2022). Several participants were critical of this initial training. Participant 4 commented on the content of the Tokyo orientation: "We were all jet-lagged, exhausted, but that's your training. There's no hands-on, like how to make a lesson plan would be a great thing for them to teach." Participant 7 criticized the training for being tailored toward ALTs who were placed in rural environments, when she was placed in downtown Tokyo: "[The training] is terrible. They were all about the things that ALTs would encounter in the countryside." Regarding the short training period, participant 17 said: "In Tokyo orientation . . . they basically said, "be polite." And that was it." Participants 21, 26, 30, and 32 remembered practically nothing from the orientation. For them it was just an opportunity to meet other ALTs who were going to the same prefecture. Before participant 19 came to Japan, she imagined that all ALTs "would have massive professional development opportunities when they arrived." However, she felt that was not the case, and said that she "was not prepared for the actual reality." The reality for her—and for many ALTs—was the expectation to immediately begin teaching without proper training. For ALTs coming to Japan with little or no previous teacher training or experience, this initial orientation in Tokyo is of paramount importance for setting the tone for their teaching careers. When ALTs express that the teacher training in this regard was inadequate, it holds significant implications for administrators and policy makers for future training sessions. Additionally, having inappropriate teacher training at this stage unnecessarily increases the ad-hoc nature of the learning-to-teach process for ALTs, and therefore does little to lessen the initial cognitive load required for performing their job with any adequacy.

For both ALTs who came to the program without any prior teaching knowledge or experience, and to an extent for those ALTs who did, much of their acquisition of pedagogical knowledge would come through the cognitive-laden process of trial-and-error. In regard to her first grammar lesson—one that ended in failure—participant 3 said, "That lesson was a mess. I have not taught that lesson again. That was way too much, way too big." Participant 25 confessed in a frustrated manner: "You think it would be easy to conduct a self-introduction lesson until you find out that your students don't like the lesson and your JTE does not know what to do then, either." In both of these cases, the ALTs were unfamiliar with their students' actual language abilities and motivations. Through this process of trial-and-error, however, the ALTs were gradually able to gather pedagogical knowledge and hone their teaching skills over time. In fact, experiencing failure and learning from it is one of the themes that appeared in nearly all the participants' stories about teaching. For instance, participant 3 had this to say about her initial lessons, "Sometimes it worked. Sometimes it didn't. It was like, Sorry class, you are my testing ground." Participant 18 praised her JTE in allowing her the freedom to try new things and learn from her failures. She stated, "Mostly, my JTEs were open to suggestions and wanted to help me and help the children. Obviously, we don't want to fail in a teaching context, but all that failure made me a better teacher, I'm sure." Perhaps most importantly, participant 1 noted:

> My advice for new ALTs would be to *indulge in a little chaos*. I think that would be my way of saying it. So let them try out some weird things. Let them see some failures, like maybe push the edge a little bit more than they should. Let them feel out those edges a little bit more, and indulge in that chaos for a little bit, because the kids generally enjoy it, from my experience, even when it wasn't a good class. Kids enjoy this attempt at doing something very different. So yeah, indulge in the edges, indulge in the chaos.

In complex dynamic systems theory, the initial conditions can have a drastic impact on the way teachers and students behave and interact. Even for ALTs with prior teaching knowledge and experience, these initial conditions affect how they re-think and re-interpret their jobs, and likely help them to adjust to their new careers (Tajeddin & mi, 2019). For ALTs who lack such pedagogical knowledge and experience, the stress and burden of learning on the job can have an even greater effect on their pedagogical education and self-reflection, especially when the initial training is insufficient and when they receive little support form mentors in their schools (Hiratsuka, 2017). The interpersonal and contextual experiences of ALTs' initial conditions play an imperative role in how they end up conceptualizing their jobs and the extent to which they go about pursuing pedagogical knowledge.

Feature (ii): Unpredictability

Feature (ii), unpredictability, is closely related to feature (i) concerning initial conditions. In natural systems that are governed by various laws or principals, the initial conditions set up a system that, over time, can yield unexpected results as many different variables within the system continuously interact. In the language teaching profession, classrooms are social spaces, and classroom occurrences can "accommodate accidental and deliberate events, both tacit and explicit knowledge, both private and public happenings" (Davis & Sumara, 2007, p. 55). According to Kiss (2012), "This innate disequilibrium means that how teaching is done and what learning outcomes it produces are both largely unpredictable and are dependent on contextual factors" (p. 19). Unpredictability, then, becomes a feature of ALTs' cognition and pedagogical knowledge development.

Unexpected occurrences for the ALTs in this study were sometimes inextricably tied to the initial conditions, encountered during the course of their teaching careers, or both. This unpredictability can begin at the onset of their careers with their school placements. Not only are ALTs unable to choose their place of employment, but the conditions of their schools can vary greatly. Specifically, classroom roles and expectations are not always clearly transmitted and cannot be reliably predicted. For many ALTs, they find themselves in a situation where there is a divorce between their previous expectations and the realities of their new jobs. Role controversy (Mahoney, 2004) in team teaching is often a central issue in this regard. ALTs are officially defined as "assistants," but upon arrival in their schools they are often asked to take charge of the lessons by acting as "T1," or the lead teacher in the teaching pair. Many participants (3, 4, 7, 8, 10, 12, 13, 14, 19, 21, 22, 23, 28, and 32) confessed that their JTEs put them in front of the class by themselves on their first day at their new jobs. Participant 10 had this to say: "The first couple of months working at the school were overwhelming [as T1]. When I took the job, I thought that I would be an assistant, and I didn't really understand everything that goes into teaching." This sentiment was echoed by participant 6 who was placed in a private high school. Upon arrival she found that she would be a homeroom teacher in an international course, which entailed many responsibilities in addition to language teaching. She felt that she was being taken advantage of as an assistant, and over time she said, "I learned I need to say no, if my co-workers ask too much of me, and that I also need to stay closer to my contract."

Aside from classroom role distribution, unpredictability and variation within specific classroom settings were other themes that recurred in the data. Participants 4, 5, 11, 17 and 20 agreed that there was wide diversity in regard to the attitudes, motivations, and behaviors of students in different school types (i.e., elementary, junior and senior high schools).

Furthermore, there was also recurring sentiment that different grades within one school—or even in different classrooms within the same grade—there existed an unpredictable variation in terms of the dispositions, aspirations, and practices of students as it related to their English language learning (participants 26, 31, 33, and 34). Participant 2 described a disordered situation in one elementary school: "My sixth graders are awesome to teach, but if you go to 5th graders, it's a mess. We have to manage the classroom. Some of them are very noisy. Some don't want to do anything." Like most ALTs, participant 4 needed to teach with many different JTEs in several different schools. He noted a great difference in how the JTEs interacted and responded to him in class. He said that at his base school "both of us try to never use Japanese" during class, but at his visit school he felt frustrated because his JTEs there "translate everything I say" or because "some JTEs stay in the back and don't really do much the whole time." Participant 16 said of his JTEs that "different teachers had different approaches to whether they would explain classroom activities in English or translate everything I say." As ALTs have no say in choosing their specific school placements, the unpredictability associated with both their placements and their JTEs' personalities is something ALTs must deal with daily. This difficulty in the learning-to-teach process needs to be addressed and overcome through substantial cognitive work on the part of ALTs.

Unpredictability also extended to the team-teaching relationship between JTEs and ALTs. One recurrent issue in the data was that ALTs were unsure of the extent to which different JTEs could support them inside and outside the classroom. For example, participants 4, 8, 13, 21, and 24related that because they were the "T1" in all of their classes, they felt annoyed and frustrated when the JTE would just sit in the back of the classroom and do nothing to facilitate the lesson, manage the classroom, or discipline disruptive students. Other issues that ALTs voiced regarded their dissatisfaction with the JTEs' teaching styles and the focus on rote learning (participants 9 and 15). Others reved that they never heard their JTEs actually speak English during class (participants 12 and 29). This was despite the fact that these JTEs taught in schools where the curriculum promulgated by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) called for communicatively based language teaching. Additionally, the curriculum called for English to be used not only as the means for instruction, but also for carrying out all classroom-related business and management (see MEXT, 2014). In these narratives, ALTs came away with negative emotions and experiences. It is easy to imagine the effects it could have on ALTs' cognition and expectations about their work (e.g., not being able to rely on their partner teachers, or having a lack of communication). These episodes go to show that the unpredictability that is ingrained in complex dynamic systems can influence ALTs' ways of thinking and their psyches in a multiplex (although almost always negative) manner, and that it can have an effect on how they deem their jobs and on how they interact with others (Hiratsuka, 2022).

Feature (iii): Having a Nested Structure

Fundamentally, complex dynamic systems are open-ended, unstable, and boundless. These systems are composed of single and multiple nested structure(s). That is to say, there are stand-alone systems layered or located within larger systems. These systems work within themselves and have vital impacts on other sub-systems as well as on the larger overarching systems. For the language teacher, this might mean that "one student in a classroom is just as complex as the group she or he works in, or as the class, the year, the school, the school district, etc. where learning takes place" (Kiss, 2012, p. 19).

The nested structure of the ALT job was obvious to the ALTs in this study. As most ALTs work at multiple schools, each school functions as an independent system. At the same time, all of the schools are governed by the educational culture unique to Japanese schools. In order to be successful, ALTs—who are themselves systems nested withing the Japanese educational environment—need to be equipped with adept knowledge and understanding about the Japanese classroom, school, and community cultures. Participant 17 mentioned: "I had to get used to the idea that Japan puts a sole emphasis on testing in their schools." Participant 19 relayed her criticism, manifesting the nested structure of her cognition: "I found Japan and its school environment very conservative and constrictive. I felt like I had a time warp, as if I was back in 1950." However, this nested structure reved by participant 19 in fact aided her in developing a stable and healthy language teacher identity as an ALT: "I found myself adapting very quickly to act like a Japanese person." For other ALTs, having an encompassing awareness of the nested nature of multiple educational contexts and systems had a positive impact on how they performed their jobs in any given school. For example, participant 35 taught in elementary, junior high, and senior high schools. The knowledge gained about the students, curriculum, and common pedagogical practices in one setting could be translated into other settings. He claimed, "Although each school has its own defining characteristics, it also has similar points." Additionally, as noted above, although participants 2, 26, 31, 33, and 34 described the different behavioral patterns of students in various grades within a single school, they did notice a common thread embedded within the macro-culture of Japan (e.g., valuing groupism over individualism). This is another layer of the nested structure on macro and micro levels that ALTs are exposed to and have to cope with in performing their professional duties.

ALTs' nested structure of their cognition also applied to their JTEs. On the one hand, they often commented on their adaptation to the idiosyncrasies of each of their different JTEs and their individual preferred teaching styles and abilities. On the other hand, many of the participants were cognizant that all the JTEs shared common dispositions as educators in Japan. Some oft-repeated sentiments included: "JTEs are oftentimes too busy to chat, let alone to collaboratively plan team-taught lessons"; and "JTEs lack the competence of English and experience in living in foreign countries." Regarding the former, participant 35 expressed his frustration by saying: "My JTEs are always rushing for time, there is basically no time for us to plan lessons or even have a brief conversation!" In reference to linguistic ability, participant 29 commented that his JTEs "have a poor command of English and have never been to foreign countries." Because ALTs generally come from a constructivist educational system and are currently nested in a different educational system, they can struggle to adapt to an educational culture and environment that is new, distinct, or even unknown (Johnson, 2009). All of the aspects of these stand-alone systems, which are nested within larger systems and constantly interacting with other stand-alone systems, shape how ALTs think, feel, and project themselves as they perform their professional duties in the given context of the moment, and as they struggle to gain pedagogical knowledge and improve their teaching skills.

Feature (iv) and (v): Non-Hierarchic Network System and Feedback Loops

Features (iv) and (v) are intimately intertwined, and for the sake of clarity of argument, they are discussed together here. Complex systems by their nature are not linear systems. As complex entities they are non-hierarchic—they are growing and moving in all directions—being therefore difficult to predict or control. For the language teacher, complex systems in education can be viewed through a social constructivist lens, as knowledge is considered to be

a social construct that is the result of interaction, shared meaning, and co-construction of all of the teachers and learners involved. Kiss (2012) argues that "in a learning environment that promotes collaboration, the exchange of knowledge and ideas cannot follow any prescribed manner or route" and contends that teacher thinking "evolves in each and every direction, travels around and bounces back," impacting and modifying its place of origin (pp. 19-22). According to Kiss (2012), this is what in complexity science is referred to as a feedback-loop—hence the strong inter-dependent connection between a non-hierarchic network system and feedback loops with respect to teacher cognition. Taken together, the pedagogical knowledge development process undergone by ALTs is non-hierarchal and contingent upon feedback loops, in the sense that pedagogical knowledge is gained in a way that is unregulated and socially co-constructed, and that its development and trajectory are highly intricate and greatly changeable.

Firstly, ALTs' pedagogical knowledge development is inconsistent, uncertain, and at the mercy of their contextual affordances and limitations within their professional and private spheres. According to participant 4, an effective ALT must be a "Swiss army knife" of language teaching. They have to constantly put on different hats for different roles, or blend into their immediate surroundings (through negotiation of their language teacher identity) on a daily, or even hourly basis in accordance with implicit or explicit feedback they receive from their co-workers, students, and other stakeholders. Davis (2003) noted "a complex phenomenon is irreducible. It transcends its parts and so cannot be studied strictly in terms of a compilation of those parts" (p. 43). Therefore, when it comes to analyzing and theorizing ALTs' pedagogical knowledge development and their cognitions during the learning-to-teach process, we cannot analyze ALTs in one specific setting or as compartmentalized characters; rather, we should examine all aspects of their collective professional careers collectively and in relation to each other. Participant 15 showcased the complicated nature of her cognition and how the feedback from others and her prior experience formulated and re-formulated her ideas about Japanese people and their way of learning English. She first expressed her adamant attitude about the importance of listening to English spoken by native speakers (i.e., ALTs) and also prized the explanations given by them: "ALTs can tell you, it might be grammatically correct, but we don't say it anymore, or it might be OK in England, but that has a very different meaning in North America, so be very careful." However, participant 15 then criticized the Japanese people's unwillingness to make mistakes, their priority on perfection, and closed-mindedness towards adopting different approaches to communication.

> I could tell that they [Japanese students] were not really trained to hear things in an imperfect way. So, as long as perfection is what is demanded, communication is impossible. If you sent me to Australia, Jamaica, or South Africa, they would laugh at me because I sound funny even though my English is fine. So, there needs to be a change in the culture in Japan.

Participant 15 might have made the former comments because of her English expert identity derived from her professional experiences in Japan, thinking that her English is absolute and that her students need to follow what they were told by her at any cost. In contrast, she might have made the latter comments because of the versatility of the English language based on her personal experiences, possibly as a result of her interaction with people around the world. There is thus often a feedback loop that mediates the learning of ALTs concerning the linguistic and pedagogical knowledge as educators in Japan.

A few other aspects of teaching in Japan pointed to teacher cognition being non-hierarchical and feedback-driven. For one, ALTs are often unfamiliar with the local culture, customs, and language in Japan, as participant 33 reved: "the biggest barrier initially was getting used to the school etiquette, school rules, and the Japanese language. But I got the hang of it later on as I stayed in that capacity longer." This participant also reved that the legacy of his predecessor and the expectations of his JTEs in juxtaposition with his own experiences set up the changing nature of his day-to-day thinking and experiences, initially leading to his feeling of inadequacy and helplessness, but subsequently enabling him to gain confidence and efficacy as a language teacher. Other issues arose concerning non-hierarchical ALT cognition related to their placements and local contexts. For example, participant 23 had worked as an elementary school teacher in her home country of Jamaica, but was placed in a high school in Japan—a context where she felt out of place. In her case, though, she later systematized her non-hierarchic network and capitalized on feedback loops, flexibly repurposing her skills and abilities she had acquired in elementary schools in her country. This was done through a process of trial-and-error—a non-hierarchal process that is dependent on feedback loops. In the journey to find a happy equilibrium in team teaching, participant 9 claimed that "communication is key, willingness to have open communication with each other." She described what she could take away as a result of the feedback loops established at her workplace: "Teaching is about relationships, relationships with the students, relationships with the administration, relationships with other teachers, so you have to build those relationships and really value and keep those relationships going." Indeed, these relationships evolved in response to a feedback loop of interaction between parties. It is primarily through this feedback loop that ALTs can hone their teaching proficiency over time (Miyazato, 2009).

Feature (vi): Emergence of Self-Organization

Complex, chaotic systems are unstable but naturally seek a condition of homeostasis. This phenomenon is known to be the self-organizing principal of complex dynamic systems. Thus, this emergence of equilibrium is the fifth feature to consider in the discussion of the complex system, and it "means that at certain times the components of participants of such a system show interaction and collaboration in a form which reveals a structure that governs their existences" (Kiss, 2012, p. 20). In education, this culmination of events might emerge as the stereotypical "teachable moment." For team teachers, this could be achieving a teaching dynamic that works incredibly well—that is, when the team teachers are being "on the top of their game" (participant 7). It is in these moments that we can consider ALTs in Japan to be an amalgamation of something larger than the sum of their one-off contributions. They demonstrate a totality of a confluence of various forces at the aggregate level.

The emergence of self-organization and the attainment of an equilibrium in team teaching was evident in the data. For some, it took time and effort, but for others it came easily and naturally as they gained a wealth of team-teaching experiences in their respective schools. Moments of equilibrium may be transient and fickle, or they may be long-lasting and steadfast, but this is only in the nature of complex systems. Regardless, this harmonization of professional attitudes and behaviors as language educators is the ultimate goal ALTs strive to attain in their new professions in a foreign country. One clear example of finding this equilibrium within a system is when contentious relationships in team teaching resolve over time. Participant 9 initially had trouble with her JTE supervisor and his teacher-centered teaching style. Initially she felt mostly marginalized and ignored in class, but over time she was able to assert herself, gradually

exercise her teacher agency, and found an equilibrium in her professional life. Similarly, it took about 6 months for participant 16 to prove to her teaching partners that she was a capable and reliable teacher of English rather than just a "human tape-recorder," but the change was a consequence of having cultivated the built-in organization within her teacher cognition. All participants related stories about serendipitous teachable circumstances, or the "aha!" moments of insight, when everything came together in successful classroom activity. These moments led to forming self-organization within their thoughts and experiences. Participant 6 and 28 shared stories about their "difficult" students and their feeling of elation and pride when those students finally graduated. In team-teaching scenarios, participant 9 described the ideal teaching dynamic that was achieved over time and with much invested effort. She said, "I have another JTE who makes a team-teaching dream-team, where you're talking back and forth the entire time and you feel like you are really matching each other." Participant 33 developed an ideal routine for his team-taught lessons with his JTEs during his four years that was both practical and collaborative: "My JTEs would let me know beforehand what topics to focus on . . . They would also ask me questions, what they can do in preparation for our team-taught lessons." It seems therefore that some of the long-term ALTs, in tandem with their familiar teaching partners, have instituted fairly stable and effective ways of considering and executing team-teaching practices, despite the inherent chaos of their linguistic and cultural environments.

It is in the nature of complex dynamic systems to counteract tensions and unpredictability with the eventual achievement of a status of equilibrium. For ALTs they function as a kind of *denouement*, or a moment of catharsis in their professional teaching careers. These moments, whether transient or perpetuating, are more prone to emerge when the ALT is able to work long-term in the same professional capacity. They serve as important junctures where all of the ALT's invested efforts for teaching and the struggle to become an effective teacher is made obvious and rewarded (Farrell & Guz, 2019; Stevick, 1976). It is the self-organizing principal of complex dynamic systems that makes it worthwhile for ALTs to carry on.

Conclusion

ALTs in Japan are positioned in a difficult yet fascinating way. The positioning and power dynamics found within the team-taught classroom have profound impacts on language teacher cognition, as ALTs engage in the learning-to-teach process and attempt to garner pedagogical knowledge and skills as team teachers. In this study, ALTs were left to "*indulge in a little chaos*" in their effort to learn how to teach without proper training or guidance from their colleagues or host organizations. There is duality in this situation. On the one hand, ALTs have some wiggle room to experiment with their ideas and activities in team-taught lessons without much scrutiny. On the other hand, they are left wondering about the overall impact and meaning of their job due to the lack of clarity of their roles and responsibilities. "Complex" and "chaotic," in fact may be the *only* words to describe the lived experiences of ALTs in Japan as they strive to establish themselves in their new chosen careers. Their journey is essentially about building important pedagogical knowledge, and thinking about and finding their place as ALTs within an unknown educational culture in a foreign land (see also Hiratsuka, 2022).

It became clear that this chaos of ALTs' lived experiences can be well-described and documented by means of Kiss's (2012) work, which mapped teachers' cognitions according to various features. ALTs' cognitions about past, present, and future teaching were both similar and diverse. As we saw, ALTs perceived or positioned themselves as mosaic and unsettled characters—as learners, as teachers, and as important team members within a complex dynamic

work environment. In regard to RQ1, ALTs in Japan learn to teach in part through mentorship by JTEs, predecessors, fellow ALTs, and even students, though the opportunity for it is often limited. More importantly, ALTs learn to teach through the process of trial-and-error. It is by this process that each ALT learns idiosyncratically about their individual educational environments and about how to teach English effectively as team teachers in Japan. As central features of complex systems, all ALTs in this study had different initial conditions as they began their careers, and there is built-in unpredictability in their school placements and with the personalities of their team-teaching partners. As a result, they all have differing paths and trajectories in their efforts to acquire pedagogical knowledge and learn about their new jobs. For some, the ALT job is a constant struggle full of ups and downs. Others seem to settle in quickly and develop empowered teacher identities. It should be mentioned, however, that an ALT's feelings and cognitions about teaching at any given point in time are only transient, fluctuating throughout their careers. This is due to the dynamic nature of the complex, dynamic system that encompasses the language teaching profession. An ALT's experiences in the workplace constantly impact ALT cognition about teaching and guide the ALT in developing a pedagogical knowledge.

Regarding RQ2, ALTs teacher cognition and pedagogical knowledge development processes can be understood through the lens of Kiss' (2012) six features of complex dynamic systems (i.e., initial condition, unpredictability, nested-structure, non-hierarchic nature, feedback loops, and self-organization), although the quality and quantity of the impact each feature has on individual ALTs varies, depending on ALTs' individual traits (e.g., personalities), contexts (e.g., urban areas vs. rural areas), colleagues (e.g., JTEs), and professional support systems (e.g., training; organizations). It is noteworthy that in the current study, Kiss's (2012) initial condition feature appeared to be the most salient and powerful for the formation of ALT cognition among the six features. This is likely due to the fact that (a) ALTs are de facto short-term teachers, often contractually limited to a maximum of five years and usually re-contracted on a year-by-year basis, and (b) it often takes substantial time and conscious effort to be in a place to review and revise one's perspectives, especially when someone is a novice teacher like ALTs in Japan. One practical suggestion, then, is that ALTs be informed of particular types and influential features of ALT cognitions discussed in this study (according to different stages of their careers) so that they can skillfully manage their professional and private lives in a foreign country. Thus, we argue that Kiss' (2012) six features of complex systems can serve as an appropriate tool to be used for viewing and analyzing ALT cognition and pedagogical knowledge development.

For ALTs in Japan, establishing themselves in a new career entails a constant, chaotic, and complex (re)assessment of their educational environments, the JTEs and students that they are working with, the ALTs' own pedagogical knowledge and abilities, and their ability to exercise agency in a given context. Burns et al. (2015) reminds us that teaching combines public and private activity. For ALTs, it is a public activity when they are collaborating and planning classroom activities, performing routines, engaging in interaction with students and other teachers, and exhibiting behaviors in or around the language teaching classroom. It is a private activity when ALTs are planning lessons, reacting to classroom events on the spot, reflecting on and evaluating their performance after a lesson, and deciding on a future course and action in language teaching. The cognitive development takes different forms in regard to specific characteristics (e.g., initial condition, nested-structure, non-hierarchic nature, and self-organization) and is mediated by various elements (e.g., unpredictability and feedback loops).

It is noteworthy that ALTs' "cognitive work" appears to be labor-intensive at the initial stage of their career, but it is highly contingent upon the initial conditions of their ALT appointments and the unpredictability found within Japanese educational system and specific working contexts. Another practical suggestion, hence, is to extend the ALT contract to a multiple-year basis rather than a yearly basis so that ALTs can be afforded enough time and mental capacity to grow and develop as legitimate educators for Japanese students. Currently, JET Program ALTs re-contract every year. If the contracts were, for example, extended from a 1-year period to a 3-year period, with the longer-term outlook on their jobs ALTs might be able to develop more positive working environments and identities, and afforded with more time to practice and hone the pedagogical knowledge that they gained in the initial months of their employment.

The current research project is not without its limitations. Focusing on only one context—ALTs who team teach in Japan—can be viewed as a limiting factor in the researchers' overall contribution to the academic field. The research framework used in the current study could therefore be expanded in future studies to include cohorts other than ALTs, such as licensed teachers in their first few years of teaching. Nevertheless, examining the cognitive work of ALTs has been helpful "to identify the deeper epistemological structures and assumptions that supported the cognitive view of language teaching, and thus both its strengths and blind spots" (Burns et al., 2015, p. 586). We need to continue in this effort by delving into a more diverse range of ALTs (e.g., a Japanese descendant) from different research sites (e.g., Brazil, Slovenia, South Korea, and Thailand). Additionally, the current study only utilized interview data. This can be viewed as a limitation, as some may argue that the data collection methods are not triangulated. Similar future studies should incorporate a wider variety of research data sources to obtain a more thorough understanding of the cognitions, identities, emotions, and experiences of ALTs.

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Appendix A: Participant Profiles

Participant	Home country	Gender	Age at the time of interview	Profession at the time of interview	Years as ALT	Base-School Placement (elementary, junior, or senior high school)
Participant 1	Australia	M	29	ALT	7	JHS
Participant 2	Peru	M	45	ALT	19	Elementary
Participant 3	Canada	F	26	ALT	4	SHS
Participant 4	USA	M	26	ALT	2	SHS
Participant 5	USA	F	23	ALT	2	SHS
Participant 6	USA	F	23	ALT	2	SHS
Participant 7	USA	F	29	ALT	2	SHS
Participant 8	USA	F	26	ALT	4	SHS
Participant 9	USA	F	29	ALT	2	JHS
Participant 10	USA	F	28	ALT	2	JHS
Participant 11	Australia	M	28	ALT	2	SHS
Participant 12	USA	F	24	ALT	2	SHS
Participant 13	Australia	F	51	ALT	2	JHS
Participant 14	Australia	M	44	Embassy Staff	2	JHS
Participant 15	Canada	F	43	Counselor	4	JHS
Participant 16	NZ	F	42	Medical Recruiter	2	SHS
Participant 17	Singapore	M	36	Swimming Teacher	2	JHS
Participant 18	Australia	F	41	Financial Analyst	2	JHS
Participant 19	UK	F	49	Univ. Lecturer	4	JHS
Participant 20	South Africa	M	38	Architecture	1	JHS
Participant 21	USA	M	31	Civil Servant	5	JHS
Participant 22	Canada	M	28	Researcher	2	SHS
Participant 23	Jamaica	F	35	Elem. School Teacher	5	SHS
Participant 24	Trinidad & Tobago	M	37	Civil Servant	4	JHS
Participant 25	Philippines	F	38	English Language Teacher	5	JHS
Participant 26	India	M	35	Engineer	5	JHS
Participant 27	France	M	27	Translator	3	JHS
Participant 28	NZ	F	30	English Language Teacher	5	JHS
Participant 29	NZ	M	29	Graduate Student	3	JHS
Participant 30	Australia	M	43	Consultant	5	JHS
Participant 31	Canada	M	40	Manager	5	JHS
Participant 32	UK	M	36	Lawyer	4	JHS
Participant 33	Canada	M	39	Administrator	4	SHS
Participant 34	USA	M	45	Web Developer	5	SHS
Participant 35	USA	M	22	Graduate Student	1	JHS