



Research paper

The networked student

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ABSTRACT

In a university Master's program, for educational professionals seeking professional development, a networked learning intervention was conducted to facilitate students' construction of learning relations for their academic development. Answers were sought to the question on how adult distance university students experience informal learning networks with peers as part of their academic socialization processes. The development of learning networks in two cohorts of students was analyzed using Social Network Analyses (SNA) at three moments during the course. Based on SNA results, 16 students were interviewed on their experiences with these learning networks. Results show that students used their learning networks for knowledge construction, for academic socialization and to mitigate feelings of social and cognitive inadequacy. Results suggest that there is a relation between the ability to engage in learning relationships, and academic socialization processes and the utilization of new knowledge in students own professional practice.

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1. Introduction

The aims of university education are traditionally multifold. Students are introduced into the corpus of knowledge and research skills that are an inherent part of their discipline of study and simultaneously acquire academic ways of thinking, interacting and communicating. However, while the acquisition of knowledge and research skills is a conscious and facilitated aim in university education, students' acquisition of academic ways of thinking is often a more tacit and serendipitous process constituted in complex negotiation and co-construction of identities (Kobayashi et al., 2017). This identity construction process takes place through participation in community activities such as reading, writing, and interacting, both with established members and with peers.

In these interactions, students are found to share both their academic and linguistic needs and expectations and their personal backgrounds. Personal goals and histories, roles and identities, as well as social, cultural, and historical aspects of their academic development become part of the academic socialization process (Kobayashi et al., 2017). In this identity construction process, learning in social configurations or networked learning, plays a

crucial role. Within informal social networks of teachers and peers, students embody knowledge, attribute meaning to it, contextualize it and share it (Baker-Doyle & Yoon, 2010). Furthermore, it is in the interaction within these social networks that the acquired knowledge is consolidated (Baker-Doyle & Yoon, 2010).

The relationship between socialization processes and networked learning in the context of academic knowledge construction is as yet as yet not fully understood (Kobayashi et al., 2017). Therefore in the reported study, some insights were gained into the complex relations between academic socialization processes and networked learning in the context of the formal curriculum. We looked into a specific context of academic distance education for adult educational professionals to find an answer to the question: 'How do adult distance university students experience the informal learning networks with peers as part of their academic socialization processes?' We will first discuss the theoretical notions that founded our research, followed by the methods we used in gathering and analyzing data. We subsequently present the results of our analyses and discuss our findings.

1.1. Academic socialization

Socialization in an academic context is the process by which university students are introduced into academic culture. It is the way newcomers interact with peers and cultivate knowledge to become members of academic communities (Kobayashi et al., 2017;

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Zappa-Hollman & Duff, 2015). Socialization can be perceived from different perspectives. Soltani (2018) describes the process from a social space perspective, in which socialization is the process of strategic negotiation by which newcomers to academic spaces internalize the norms, ideologies and expectations of the academic space. Lave and Wenger's community of practice theory (Lave & Wenger, 1991; Wenger, 1998) describes socialization processes as Legitimate Peripheral Participation: Newcomers make their way from the periphery of a community to the center, gaining an understanding of common norms and practices by interacting with more knowledgeable members, enabling them to develop into leading experts themselves.

From a networked learning perspective, socialization can be described as a similar process (Schreurs, 2019). Becoming a member of a network means constructing learning relationships or learning ties with other members by interaction, thus constructing the systems of knowledge and values of that particular network. The relationships in networks may differ in strength, especially as compared to the relationships in communities of practice. Learning networks are made up by both strong and weak ties and membership is based upon common learning needs, rather than shared goals and collective identities (De Laat & Schreurs, 2013).

In research on organizational socialization, Morrison (2002) attributed three types of knowledge construction to socialization. The first consists of knowledge of contextual issues and attributes (such as norms, policies, reporting relationships, terminology, goals, history, and politics). The second is knowledge of how to perform specific tasks, e.g. procedural knowledge, and the third is knowledge of role expectations and responsibilities (Morrison, 2002). Socialization is therefore both a learning process and a process of becoming. Students not only acquire knowledge and values connected to the academic discipline they enter, but they construct an academic identity by positioning themselves in the academic community and by taking part in academic practices (Soltani, 2018). In this identity construction process, students use practices such as drawing on personal experiences and using informal language to make sense of the new community they are entering (Chang & Sperling, 2014).

Stahl (2000), who grounded the socialization process in a social epistemology, stated that individuals generate personal beliefs from their own perspectives, but they do so on the basis of socio-cultural knowledge, shared language and external representations. These beliefs become knowledge through social interaction, communication, discussion, clarification and negotiation. Knowledge is therefore an inherently socially mediated product (Stahl, 2000).

The relationship between the academic context and the construction of social relationships plays an important role in collaboratively negotiating norms and knowledge and comparing and contrasting them with previous learning (Soltani, 2018). This process is facilitated by the interplay between emotional and academic support that students receive from various socialization agents, such as teachers and peers (Kobayashi et al., 2017). Although socialization has often been regarded as a process in which experts teach novices, like teachers teaching students, research illustrates the importance of the role of peers in socialization (Friedman, 2021; Zappa-Hollman & Duff, 2015). Friedman (2021) argued that the concept of 'expertise' is fluid. This means that expertise may shift across situations and between interactions, especially in settings in which people with diverse educational and professional backgrounds, participate. Expertise in such situations may be interpreted as the positioning of individuals 'along a continuum of more or less 'knowing' in a particular knowledge domain' (Friedman, 2021, p. 6). In Zappa-Hollman and Duff (2015), students' socialization is largely achieved through academic study-related

interactions with more experienced students and with newcomers who share similar backgrounds, concerns, and goals. Zappa-Hollman and Duff (2015) stress the role of peers in academic socialization, suggesting that interaction with peers could be equally beneficial for socialization as interaction with more established members.

1.2. Networked learning

A network is a social structure that consists of individuals connected with each other through multiple relations. These relations, or network ties, can be informal, based on feelings of affectivity, or formal, prescribed by structures or contracts, or a combination of both (Pataraja et al., 2014). Network ties may vary in terms of direction, frequency and strength (Haythornthwaite & De Laat, 2012), but they all function as conductors, through which feelings, behavior, ideas and knowledge are transmitted, negotiated and constructed. Networked learning is concerned with the learning processes constituted by these ties. These learning processes are often informal, serendipitous and tacit, driven by the agency of learners fueled by a need to solve a variety of problems.

The number of ties, the particular position in a network and the perceived quality of the ties influence the access to knowledge and other resources of the networking individual. When people have more ties with other well-connected individuals they generally occupy a more central position in the network (Moolenaar et al., 2014). Well-connected individuals have a higher degree of centrality. A higher degree of centrality means that a person has access to a greater number of social resources within the network (Lin, 2009; Molle & Prior, 2008). More ties or a higher degree of centrality offers greater potential for knowledge construction (Nahapiet & Ghoshal, 1998; Van Waes et al., 2016).

Networked learning is receiving increased attention as a way to stimulate professional development (Huijboom et al., 2021; Meijjs et al., 2016; Vaessen et al., 2014) and to provide professionals with the opportunity to regulate their own professional development in line with their professional needs (De Laat & Schreurs, 2013). Learning in networks is also believed to lead to a more efficient flow of complex knowledge within organizations and to stimulate innovative behavior (Coburn et al., 2013; Moolenaar, 2012). Actively stimulating learning in learning networks within organizations is believed to open up the social environment to make optimal use of possibilities to connect to others and draw upon their social capital (Moses et al., 2009; Vaessen et al., 2014).

Networked learning can be stimulated based on three conditions (Nijland et al., 2018). The first condition is *awareness*: only when learners become aware of their social network and the knowledge capital their network contains, they can consciously and actively use what their network has to offer (De Laat, Schreurs, & Nijland, 2014). Creating visualizations of the ties between people and the knowledge they share in network diagrams facilitates and stimulates this awareness (Cross et al., 2001). The second condition is *ability*. Knowing where to find knowledge is the first step, but effectively using the knowledge of a social network requires certain skills. A necessary skill for networked learning is being able to construct a relationship of trust and reciprocity with others (Rivera et al., 2010). A second skill for networked learning is the ability to construct an accessible and relevant learning network that offers learners a way to achieve their learning goals (Nijland et al., 2018). The third condition is *appreciation* of the value of networked learning: When learners are aware of the value of networked learning, it stimulates the conscious use of their social network for their professional development (Van Waes et al., 2016).

To assess value in networked learning, Wenger et al. (2011) created the value creation framework (VCF). Value is defined as

both the process and the revenues of network and community engagement. Value is a personal attribution to a concept or an activity, and therefore always subjective. Wenger et al. (2011) define learning as a process of value creation, which is more than the acquisition and production of knowledge and skill. It is also the feeling of enjoyment and the satisfaction of basic needs (cf. Ryan & Deci, 2000), it is making new contacts, experimenting and changing practices. Furthermore, created value not only affects the learner and the network in which this particular learning takes place, but also the people in the learner's broader social network, those who experience the effects of the value created by the learner. Based on this impact, learning can be considered an inherently social event.

The characteristics of networks and socialization processes experienced through those networks in the context of the first course of an educational Master's program, lead to an addition of two sub questions to our main research question 'How do adult distance university students experience informal learning networks with peers as part of their academic socialization processes?'

1. What are the characteristics of the informal learning networks that adult distance university students create?
2. What socialization processes did students experience through participating in informal learning networks?

2. Methodology and methods

2.1. Design

To provide insight in the construction of informal learning networks by distance university students the present mixed-method, exploratory study made use of social network analyses (SNA) (Daly, 2012) at group level and of value creation interviews (Wenger et al., 2011) at student level. The SNA was conducted in two cohorts of students in which networked learning was introduced as part of the curriculum. SNA outcomes provided data on network development and served as input to select students of each cohort for a value creation interview at the end of the course. These interviews provided data on the nature of the use and revenues of the learning networks of the selected students.

2.2. Context

The study took place in the context of an academic Master's program on Educational Science offered by the Dutch Open University to adult educational professionals, mainly teachers. The program was based on distance learning with online courses and a limited number of face to face activities. The language of instruction was Dutch, complemented with scientific literature in English. The students, who already held a degree in Applied Sciences, enrolled in the program seeking an academic degree as part of their

professional development. As they were working professionals, they were interested in knowledge and approaches that would enrich their teaching practice; they valued authenticity in learning and the applicability of learning tasks to their professional practice (Radovic, Firssova, Hummel, & Vermeulen, 2021).

The reported study was conducted in the first course of the Master's program. In this course students were required, often for the first time, to act as educational researchers, applying knowledge of learning theories, educational design and methodology. In this eleven week course students conducted a case study, comparing the learning principles derived from an observation of an authentic classroom instruction with the theoretical learning principles derived from the formal educational perspective of the school where they conducted their case study. Mid-course, students presented their research findings and discussed them with each other during online poster presentation sessions. To finish the course, students wrote an individual research paper for assessment.

The course started with a 6 h face to face introduction event with teachers and students. After this, course interaction solely took place through regular online virtual classes and asynchronous communication in discussion forums. Halfway through the course of the second cohort, Covid-19 measures were taken, but since the face to face event already had taken place and regular interaction was already online, this did not influence the way the course was taught.

A networked learning task in which students were introduced to and trained in network awareness, ability and appreciation (cf. Nijland et al., 2018) was integrated into the introduction event (Fig. 1). To make students aware of their learning network, both at the start and at the end of the introduction event, and at the end of the course SNA was performed and social networked diagrams (cf. Figs. 2–3) were created to visualize the ties between students in the course. In addition, students were asked to share and discuss their personal learning goals and the areas of their knowledge and expertise, thus making the social capital of the cohort visible and facilitating collective access to it. Throughout the course, students had ample opportunity for interaction. Collaborative tasks, peer feedback and organized verbal exchanges of observations, experiences and standpoints both in online classes and during the online poster presentations were to stimulate the formation of learning relationships with peers.

2.3. Instruments

To gain insight in the learning relationships between students at a group level, SNA (Daly, 2012) was used. Students were asked to list fellow students with whom they had one or more valuable conversations. 'Value' was defined as an inherently individual yet significant attribution to an experience based on the definition of learning as a process of value creation by individual learners, or a

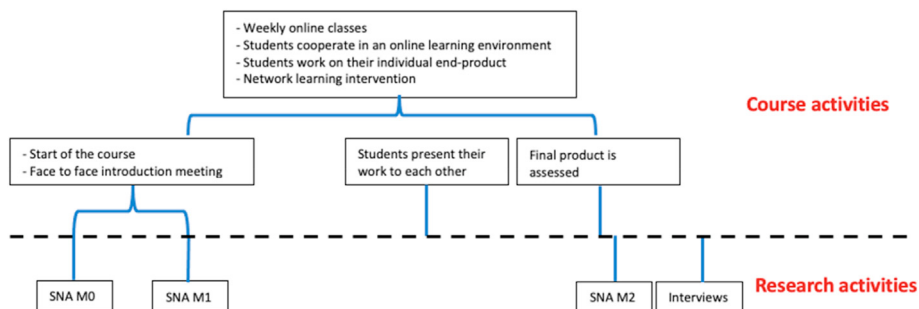


Fig. 1. Schematic representation of course elements in relation to research activities.

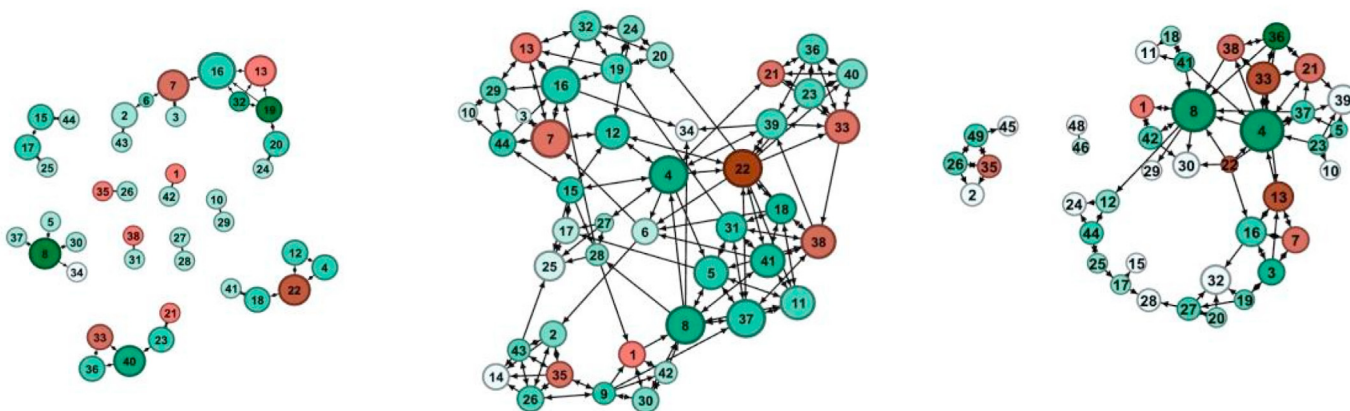


Fig. 2. Cohort 1, learning network diagrams at M0, M1 and M2.

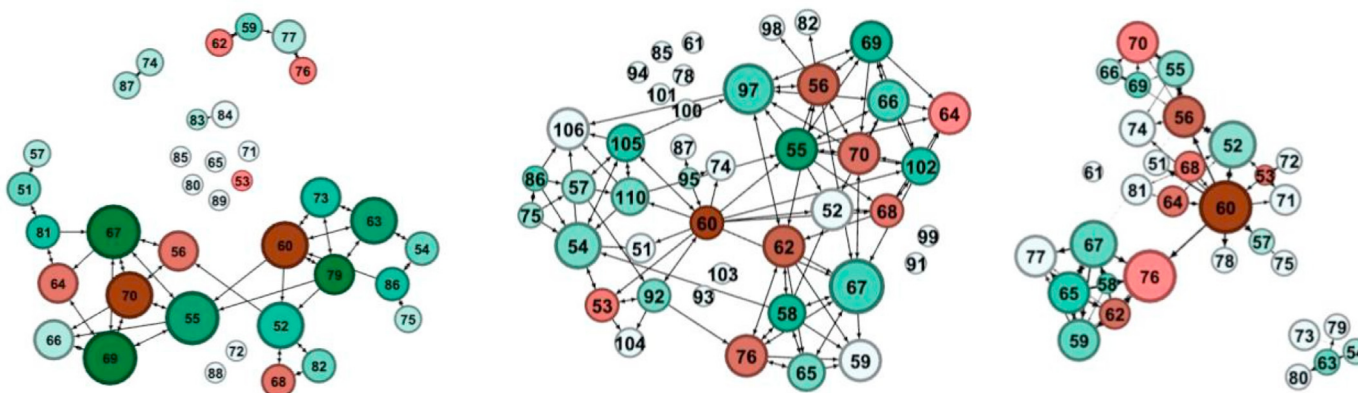


Fig. 3. Cohort 2, learning network diagrams at M0, M1 and M2.

Note. Interviewees in red

community of learners (Wenger et al., 2011). ‘Value’ in this research was operationalized as a significant and personal attribution to an experience a person or group had undergone. It was communicated as: ‘A conversation is valuable when you experienced it as valuable’. Data was gathered three times in every cohort and analyzed using Gephi (Apostolato, 2013). Visual representations of the networks as social network diagrams were generated (Figs. 2 and 3) and degree centrality was determined. Degree centrality represents the number of the incoming and outgoing contacts of a member of a network. Indegree refers to ‘incoming’ connections or all instances others mention a certain person as a ‘valuable relation’. Outdegree refers to outgoing contacts or instances a certain person mentions someone as a valuable learning relation.

Value creation interviews (Wenger et al., 2011) were used to explore students social learning activities and their revenues. They were guided by seven questions (Wenger et al., 2011, p. 38):

1. What did you hope to achieve in the course?
2. What activities with peers did you employ during the course?
3. How did you experience these activities?
4. What knowledge, instruments or insights did they bring you?
5. How did this influence your daily practice, both as a student and as an educational professional?
6. How did this affect you, your peers, your pupils or other stakeholders?

7. What fundamental changes in perspectives (if any) did this bring you?

To stimulate in-depth conversations, the above cited suggestions from Wenger et al. (2011) were used in an extensive interview guide with open-ended questions and topic suggestions for follow-up questions. The interview started open, with questions about the experiences with the course and relations with peers in general. Based on the answers of the interviewee more specific questions were asked to map the mentioned experience in detail. Examples of the follow-up questions are: “What was the interaction with your fellow student like? How did you experience it?” (Immediate value). Or “What did this conversation bring you?” (Potential value).

2.4. Procedure

The Ethics Review Committee of the Open University of the Netherlands granted approval for the study. Data for SNA was collected in two cohorts of students of the same course. The first cohort consisted of 45 and the second cohort consisted of 61 students. Three SNA measurements were conducted; (M0) before the start of the course, (M1) after the face to face meeting and (M2) at the end of the course (Fig. 1). Although students were asked for the names of valuable contacts, learning network diagrams were all fed

back anonymously to increase network awareness, using numbers instead of names (cf. Figs. 2 and 3). Not all students agreed to participate in the research project and not all students filled in all questionnaires. The total number of responding students per measurement is presented in Table 2. When students mentioned learning relations with students not participating in the research project, the data was not used, so the network diagrams only include students who agreed to participate.

Interview participants were selected at the end of the course using stratified sampling, derived from the third social network analysis (M2) performed at the end of the course, based on the in- and outdegree measures. Invitations for participation in the study were sent after course final assignments were graded so that the interviews did not interfere with performance assessments. Interviews were scheduled within the range of several weeks after course completion so that students would still remember activities clearly but would have had time to reflect on their process as recommended by Wenger et al. (2011).

Nine students in each course were asked to participate, aiming at an even spread of connectivity in participants, resulting in indegree ranging from 0 ties to 6 ties and outdegree ranging from 0 to 10 ties. All invited students but two, agreed to participate in an interview, resulting in 16 interviews of about an hour (cf. Table 2).

2.5. Data analysis

Social network analysis data was analyzed by creating social network diagrams of every measurement and by calculating indegree and outdegree. To examine whether significant differences existed between the three measurements within a cohort, Friedman's test was used. Man-Whitney's U test was used to control for differences between cohorts at the various measurements.

The analyses of the interviews started with transcribing all 16 interviews verbatim and dividing them into units of analysis. Transcriptions were subsequently analyzed in an inductive process using Atlas-ti. Coding was conducted in three phases: open, axial and selective coding (Creswell & Creswell, 2018). Based on the axial phase a codebook was constructed, which was used by a second researcher to analyze two randomly chosen interviews to calculate interrater agreement using Cohen's kappa. Kappa was established at 0.78 which is considered sufficient (Warrens, 2015).

3. Results

3.1. Learning network development: cohort perspective

In both cohorts most students constructed learning relationships with peers throughout the course, resulting in learning networks of students (see Figs. 2 and 3). The Mann-Whitney-U test revealed no cross-sectional differences between the cohorts regarding in- and outdegree at the three measurement points ($p < .01$).

At the start of the course, in both cohorts in- and outdegree in terms of means and medians were low. After the introduction event both were relatively high and at the end of the course the learning relations were lower than after the introduction event, but higher than at the start of the course. The Mann-Whitney-U test revealed no cross-sectional differences between the cohorts regarding in- and outdegree at the three measurement points ($p < .01$). According to repeated measures analysis, the differences between indegree and outdegree measures at the start of the introductory activity, the end of the introduction and the end of the course were significant (see Table 1).

Due to the context of the course, In both cohorts, the networks at the start of the course (M0) consisted of a limited number of ties

Table 1
Number of respondents, Means and Medians of the in- and outdegree in the Two Cohorts and Friedman Test Statistics.

			Descriptives			Friedman's test		
			n	Mean	Median	χ^2	df	P
Cohort 1	Indegree	M0	40	1.63	1	46.5	2	<.001
		M1	44	4.74	5			
		M2	41	2.40	2			
	Outdegree	M0	40	1.60	1	37.7	2	<.001
		M1	44	4.89	5			
		M2	41	2.57	3			
Cohort 2	Indegree	M0	38	1.91	2	53.1	2	<.001
		M1	43	4.47	5			
		M2	31	2.62	2			
	Outdegree	M0	36	1.84	1	40.7	2	<.001
		M1	43	4.60	5			
		M2	31	2.62	3			

between students. After the introduction event (M1) containing a network learning tasks and informal moments, students in both cohorts, with a few exceptions, reported a more substantial number of valuable ties, resulting in a well-connected network. At the end of the course (M2) after only online learning with spare collective encounters, the network configuration was less dense than after the end of the first meeting (M1) but still denser than during very first measurement (M0). When comparing M1 and M2, we see that students generally appeared to have lost some ties, but have kept others, as Figs. 2 and 3 illustrate.

3.2. Learning network development: individual perspective

Analysis of the learning networks at individual level, demonstrated different ways of learning network development. For example, Cathrin (33, Fig. 1) started with two reciprocal relationships (36, 40), but developed to a more central position in one of the clusters and kept this central position at the end of the course (M2), although the students she connected with differed from the ones in M0 and M1. Charlotte (22, Fig. 2) demonstrated a different pattern: she started the introductory meeting with two reciprocal learning relations (4 and 12). At the end of the day (M1) she had developed as a central figure, and still had reciprocal relations with student 4 and 12. Furthermore, she had a linking position between three more dense clusters within the learning network which were formed around number 16, 33 and 41. However, at the end of the course (M2) Charlotte had lost her central and linking position in the network. Although she reported five learning relationships, overlapping with the ones in M1, none of the other students mentioned her as a learning relation.

3.3. Learning relationships: a closer look

SNA analysis combined with the analysis of the sixteen interviews allowed us to construct an overview of learning relationships and their impact from a value creation and academic socialization perspective. This overview is presented in Table 3 which is organized by the indegree measures for M2, starting from no incoming contacts (named by none of the participants) to many. Table 3 furthermore contains the results of both inductive and deductive coding.

Two mechanisms were distinguished from the way students reported on their construction of learning relations. The third and fourth column of Table 3 contain the number of references to these mechanisms: 1) *serendipity*, when students constructed learning relationships with whomever they came in contact with and 2) *resonance*, when students tacitly searched for learning relationships

Table 2
Interviewed students, their professional background and in- and outdegree.

ID	Name	Professional background	Sector	M0 In	Out	M1 In	Out	M2 In	Out
1	Susan	Teacher	Primary education	1	1	5	3	2	2
7	Renata	Teacher	VET	3	2	7	5	3	3
13	Bernardine	Academic counsellor	University of Applied Sciences	3	1	5	4	4	5
21	John	Aid worker	Government agencies	1	1	4	5	4	3
22	Charlotte	Teacher Math	Secondary education	3	3	7	11	0	5
33	Cathrin	Special needs coordinator	Primary education	2	2	6	5	5	5
35	Donna	Teacher	VET	1	1	4	5	2	3
38	William	Teacher	Secondary education	1	1	6	6	3	3
53	Frankie	Teacher	Secondary education	0	0	3	3	0	4
56	Deborah	Homemaker		3	2	5	7	4	6
60	Jill	Teacher	Primary education	4	5	3	11	6	10
62	Ziggy	Teacher	Primary education	1	1	5	7	2	5
64	Walter	Educational trainer	Police	3	2	5	0	2	4
68	Karen	Special needs coordinator	Primary education	2	2	3	4	2	3
70	Lauren	Teacher trainer	University of Applied Sciences	4	5	5	5	4	1
76	Roberta	Aid worker	Government agencies	1	1	5	5	6	0

Note. ID numbers correspond with ID numbers in Figs. 2 and 3.

Table 3
Overview of interviewed participants: mechanisms for the construction of learning relations, experienced socialization processes and utilization, ranked by indegree measures of M2 (n = 16).

ID	Name	M2 In-degree	M2 Cen-trality	Seren- dipity	Reso- nance	AA	AI	AS	U*	SA*	CA*	MF*
53	Frankie	0	4	2	0	10	0	0	0	0	0	2
22	Charlotte	0	5	2	0	4	0	0	0	3	3	1
1	Susan	2	4	2	2	3	1	2	9	4	1	1
35	Donna	2	5	1	0	2	2	1	2	0	0	0
68	Karen	2	5	2	0	10	4	0	3	5	1	5
64	Walter	2	6	2	0	8	4	3	13	0	0	2
62	Ziggy	2	7	2	1	6	4	5	2	0	0	0
7	Renata	3	6	1	1	2	3	1	4	1	0	1
38	William	3	6	1	1	3	2	5	9	0	0	1
70	Lauren	4	5	3	3	10	4	6	7	0	0	0
21	John	4	7	3	0	4	3	1	2	0	0	0
13	Bernardine	4	9	1	1	0	1	0	7	0	0	0
56	Deborah	4	10	1	7	0	1	11	0	5	0	5
33	Cathrin	5	10	0	1	3	3	1	3	0	0	0
76	Roberta	6	6	1	2	4	14	5	9	0	1	1
60	Jill	6	16	0	4	6	5	3	8	0	4	3

U = utilization.
SA = social anxiety.
CA = cognitive anxiety.
MF = mitigation fiction.

that suited their learning needs and subsequently constructed them.

Column four to six in Table 3 present the way students used their learning relationships. Students used their learning relations to check whether their perceptions and interpretations of academic expectations were correct (*academic alignment, AA*). They also used them to construct knowledge in interaction (*academic interaction, AI*) and they used their learning relations for *academic socialization (AS)*. Furthermore, as represented in column seven, they used knowledge created in the course in their everyday educational practice (category: *utilization*). Finally, column eight to ten, contain the number of reports on feelings of both *cognitive* and *social anxiety* when starting the course and how their learning relations functioned to mitigate these feelings (*mitigating friction*).

Table 3 suggests some relations between indegree and other variables. The mechanisms through which learning relations were constructed by the participants appeared to be related to their indegree (incoming contacts). Students with a higher indegree reported less serendipitously constructed learning relations and more construction through resonance. Furthermore, academic

interaction, academic socialization and utilization of knowledge in own educational practice seemed to be reported more often by students with a higher indegree. Combining information about professional background and the sector where students were employed (Table 2) with the information on learning relationships such as indegree, resonance, value creation or socialization processes (Table 3) shows no indication of a relation between these variables.

3.4. Constructing relationships: serendipity and resonance

Students described the mechanism through which they constructed learning relationships at the introduction event as serendipitous. They often connected with peers who coincidentally sat nearby during the introductory meeting. Some students used words like *organic* or *emerging* to describe the process of constructing relations with others:

How did we started our collaboration? Well first with people who sat nearby in class. [...] I didn't play an active part in this.

The three or four of us, we connected organically. And later on our group got even bigger. Through 'whatsapp', the [online] forum, people connected with us. I had no influence on that, I think. Our relations emerged. It took no conscious effort. (21 John)

Other students described that later on in the course the serendipitously formed learning relations not always met students' learning needs. Below Deborah describes a process of tacit agency as a mechanism to construct learning relationships:

We started using 'whatsapp', and this large group of 8 people, they said: I'll see or I don't. But [I wanted to know:] how do you interpret this? I don't understand this. There was little response to these questions. Or none at all even, except for a few people who experienced the same, who also wanted to talk about the learning process instead of just focusing on targets and handing in stuff. How do I put this? Maybe it's a coincidence [...] but people see what you are doing and they join you when it resonates with them, and if it doesn't they don't. I think. [...] We formed a kind of group inside a group. We didn't quit the group but we formed an app-group alongside it. We started a new conversation. (56 Deborah)

Deborah described the mechanism of connecting with people with the same needs as 'resonance': 'people see what you are doing and they join you when it resonates with them'. By being an active student and by communicating learning needs, Deborah showed others what she needed in her learning process, providing students with the same learning needs with the opportunity to connect, facilitating the construction of learning relationships that matched their learning needs. The construction of learning relationships usually started out serendipitous, but some students described the mechanism of resonance as the course went on.

3.5. Academic alignment

Students reported on 'academic alignment' (AA), when they used their learning relationships to check their interpretations of what was expected of them, both in terms of tacit academic expectations and in terms of correct grasps of the knowledge students were to acquire. The question 'Am I doing things right?' was central.

We met a few times in our own virtual class because I had some questions. Not everyone joined, but still, there were two others. And I really like to check whether I see things right. So that's exactly what I did. [76 Roberta]

By aligning academically most students used their learning relationships explicitly to acquire insights, information or knowledge as a means to successfully finish the course. They appeared to be selective in when they used their learning relationships for academic alignment and when they used them for more substantial interaction:

There was one person I had more contact with, we formed a group within the group. For instance, I was working on constructivism and at times when I doubted something, I briefly called her: 'What do you think about this?', this way I was able to continue quickly, while if I had discussed this with the four of us, it would have taken a full day to get a response and I would have gotten two different answers. To work more effectively this was the strategy I used. Short blows on my own, bigger problems collaboratively. [64 Walter]

They described the use of their learning relationships as a balancing act in which study progression and in depth discussions appeared to be perceived as opposing goals. Discussing problems and questions in a larger group took up time, not only because of the fact that multiple perspectives needed to be aligned, but also because of the distance educational context in which students did not always work synchronously. Deciding to put something up for discussion meant a delay in study progression, so as Walter described: the use of learning relations for more substantial interaction needed to be a conscious decision.

3.6. Academic interaction

Another aim for which students used their learning relations could be described as 'academic interaction'. Most interviewed students used their learning relations to come to a joint perspective on both the knowledge that was to be acquired during the course and on the way students should behave as aspiring academics. A majority of these students enjoyed academic interaction with their peers and stated it helped them to get a grip on the exact content:

[It was nice] to just hear what others have to say, their perspectives, the questions they ask. It lifts you up in your thinking process. Every interaction adds something or it makes your own vision or thought process sharper. [76 Roberta]

Other students described the value of academic interaction with peers as a tacit process, as Donna put it: 'learning a lot without learning in a traditional manner. Almost without being aware that you are learning' [35 Donna]. Since most students reported to enjoy their academic interaction with peers perhaps the learning that took place didn't feel like an effort.

I can imagine when you are all alone in a course like this or when you only know people vaguely, it would be a lot more difficult and a lot less inspiring. While if you are in contact with others, and that is why I kept looking for contacts outside my study group, you learn from each other and gain experience. That way it is just fun, because I do this mainly to learn a lot. [33 Cathrin]

Many students connected the academic interaction they had with their daily practice as a teacher, like Karen did. In the quote below she states how she doubts how to interpret a situation she observed, relating her doubt to the doubt she feels in her everyday work:

We had to observe a case, and analyze which learning theoretical principles we could derive. And then a discussion started about whether something was cognitivism or constructivism. And I thought that was really informative, because of course in your own practice you also wonder about these things sometimes. And well, in your daily practice that is not such a big deal, but in this study task it is. So you discuss this, and that's maybe also how you change your perspective. [68 Karen]

The academic interaction affected the way students perceived their social relationships. Some indicated to appreciate and enjoy diversity in perspectives and how these diverse perspectives made them see things in a different way and led to behaving as aspiring academics.

I first thought to observe a case on my own school, nice and convenient. But then a fellow student asked: why would you

choose that, it can be a pitfall. It could be nice to go somewhere else and observe there. And then we discussed the pros and cons of observing at your own school. And finally we concluded that we were going to search for a different school. [1 Susan]

Susan reports a discussion with a peer on whether or not to search for a school outside their own professional context. Together they decided to observe somewhere else, to avoid the objectivity pitfall. In these kinds of conversations academic norms are discussed and made meaningful by relating them to students own situations.

3.7. Academic socialization

Many students described how the interaction with peers affected their thinking process. They indicated interaction sharpened their thinking, resulting in a changed perspective on the course content but also on themselves as aspiring academics. As Jill put it:

You evolve by means of each other [...] because you learn to see everything through the eyes of science. When people state something, I think: hello, wait a minute. Or when a study is mentioned, now with the corona-situation, you look at everything through an academic lens. [...] You can't just say something without proper argumentation on scientific grounds.[60 Jill]

Most students reported these changed perspectives on themselves, describing them as a different way of looking at reality, a new framework. Many interviewed students reported starting 'to see through the eyes of science', applying academic skills like critical thinking, appreciating evidence and an attitude of curiosity. They actively connected the development of these skills with the interaction they had with their learning relationships ('You evolve by means of each other'), or as William describes below.

The collectiveness, being in contact with fellow students, but it [the interaction] is really about the content. That was important to me. Very valuable. That you really learn to write objectively and to see with scientific eyes. I now often think: Is this really the case? What are we doing? Why are we doing it this way? Has this been studied before? [38 William]

Collective interaction in the academic community students entered, changed the way some students looked at themselves as learning individuals, learning to appreciate the value of working together to improve results and realizing that there isn't always a truth or a right way of doing things. It also changed the way they perceived their surroundings: both in the way society communicates about scientific studies (cf. Jill's remark on Corona) but also in the way students looked at work related issues.

3.8. Knowledge utilization

Most students (cf. Table 3) reported on the utilization of knowledge, insights and of the academic norms they constructed in the course in their everyday work practice. Colleagues appeared to be interested in learning about and using tools that students developed in the course. However, the new perspectives and frameworks students acquired, distanced some of the students from their colleagues at work. Students reported friction between

their new frame of reference and the frame of reference of colleagues. Walter described this in the following way:

You can't go back to the old level the others are still at. And that is a risk. Clashes occur. I learned to asked questions. Not to hesitate, but to ask why-questions. I think that's complicated because I see things differently now and then I think: am I on an island? Should I go this way or that way? Is this better? Why don't they follow me? Why doesn't this work? [64 Walter]

Walter described a discrepancy between his 'level' and the level of his colleagues, resulting in feelings of solitude and fundamental doubts on the right course of action in interacting with colleagues. However, Renata described in one of her clashes that perseverance in communicating her newly acquired frame of reference did eventually lead to an experienced shift in the way her contributions were received.

Our school wants to work with Team Teaching, and then there are teachers who say 'Well, if this is what the board wants us to do, we'll do it.'. However, I wrote an article on co-teaching and I discovered some downsides. So I said: 'There are downsides to Team Teaching. To what extent did you take them into account?' And then they just ignored it. And I thought: 'Hello, I asked a question!' And later on I went to the head of the school and I said 'You know I'm doing a master, you yourself know that there are downsides, why don't you just acknowledge that?' I know, they just want to innovate, but hey, they can make a plan to tackle these downsides, instead of just skipping the question and moving on. And now I notice [...] that they gradually start taking it into account. They come to realize they can't just shove me aside. They have to found their arguments scientifically, think about it in advance and recognize potential problems. Simply declaring that we do this innovation, is not okay. [76 Renata]

Renata clearly communicated her new standpoint inside her school: 'they have to found their arguments scientifically'. And although at first she was ignored, since her contribution deviated from the response of her colleagues 'we'll do it', her perseverance appeared to result in a gradual change into the way her contributions are perceived.

As Table 3 shows, all but three students reported knowledge utilization. One was Deborah (56), who was a homemaker and did not have a professional practice to apply knowledge to. The other two were Frankie (53) and Charlotte (22), who did not report academic interaction and socialization either. These two students also were not mentioned as a learning tie by other students in M2 (indegree 0).

3.9. Use of learning relationships: a mitigating effect

In the way students described their entering of the academic community, personal feelings of inadequacy appeared to be an important theme for some. Five students indicated that they were stressed by the fact that they were assumed to create learning relationships and networks with peers. They considered themselves to be not very sociable and the social expectations of the teacher made them question their abilities to acquire the necessary skills.

And then the teacher's opening line: take a good look at each other, you are each other's social capital and you'll need each other. And then I got scared. [...] I thought can I do this? I am

very introvert. I used to suffer from social anxiety, I was bullied as a child. A sense of community doesn't come natural to me. [56 Deborah]

Six students expressed their doubts in being bright enough to successfully participate in the Master's course. They feared they might not fit in intellectually and were intimidated by the university context.

In group work I often feel: they are all so good. You have to apply yourself, pretend to be smarter and better than you are. Others seem so much smarter than you. I really suffer from feeling dumber than everyone else. I felt this way at the start of the course. [22 Charlotte]

These feelings of inadequacy may indicate a conflict between students' self-image or perceived identity and the systems of knowledge and value that the new community entailed. The new community demanded certain social and intellectual skills that these students thought not to have. However, the learning relationships students constructed appeared to have a mitigating effect on these feelings of inadequacy. Students with social fears discovered the pleasant and beneficial effects of a supporting network and realized that they were not as unsocial as they expected. Those students perceived their learning network as a safe space in which they felt free to show their vulnerabilities and to ask for peer assistance:

I think I look at it [constructing learning relations with peers] differently now. You are vulnerable when you indicate that you don't understand something or need help. I think I was afraid to show this vulnerability during the pre-Master's course because I didn't know anyone. And I now that I do, I am not afraid anymore to be vulnerable: 'Okay, I need help, so I seek help'. [53 Frankie]

The mitigating effect of learning relationships on feelings of inadequacy also resulted in a shift in the perspective of some students on the role others play in their academic achievements.

I always experienced giving and receiving feedback as stressful. I am always a bit insecure about what I wrote down, but in collaboration [in the course] I discovered how pleasantly people give feedback and how much better your work actually gets. And now I even look forward to it. When I've written a piece, I think 'Oh what do others think about this. And what can they add?' Your work really gets better when you work with others. [38 William]

4. Discussion

The study explored how adult distance university students created and used informal learning networks with peers, guided by two sub questions: 1) What are the characteristics of the informal learning networks that adult distance university students create? and 2) What socialization processes did students experience through participating in informal learning networks?

Concerning the characteristics of the informal learning networks students created, we found that students started the face-to-face introduction event with just a few ties between each other. During the event the construction of learning relationships between students was stimulated by networked learning activities and afterwards education proceeded online. The SNA showed that during and after the introduction event students constructed

learning ties. By the end of the course, it appeared that a number of ties were consolidated, while others had vanished or were replaced by new ties. The network formed at the end of the eleven week course was less comprehensive or dense compared to the end of the intensive interactive introduction event. This was confirmed by the in-depth interviews in which students reported on two mechanisms for the construction of learning ties. Initially students' learning relationships were constructed serendipitously. However, as the course progressed, some students lost ties or realized that their learning needs were not met by existing ties. They reported on the construction of learning relationships by the mechanism of resonance. By communicating learning needs, which received uptake by peers, supportive learning relationships were constructed.

The second sub question regarded the socialization processes students experienced through their participation in informal learning networks. Students described academic alignment, to check whether their interpretations of the norms and knowledge of the academic community aligned with those of peers. They described academic interaction, when constructing academic knowledge in conversation with others and they described academic socialization, resulting in altered perspectives on science and everyday practice. Students used the knowledge and perspectives they constructed in the Master's course in their everyday educational practice, although this often resulted in conflicting situations with colleagues that held different perspectives. Finally, students reported on feelings of both cognitive and social anxiety when starting the course. Their learning relations mitigated these feelings.

The academic socialization, the students described, resembles aspects of academic habits of thinking (cf. [Blalock et al., 2008](#); [Noll, 1935](#)), which encompasses critical thinking, objectivity, meticulousness, appreciating evidence, intellectual honesty, openness and an attitude of curiosity. The students that participated in this study constructed a learning network in which they could construct and practice these habits of thinking. This is in line with research on academic discourse socialization. Academic discourse can be defined as the ways of using language and the ways of thinking that exist in the different academic disciplines ([Hyland, 2009](#)). The role of discourse is central in academics. Discourse provides the means through which ideas are shared, constructed and communicated, and at the same time discourse constructs the social roles and relations which create both academics and students, and which sustain not only academic macro structures like universities, faculties and disciplines, but also the creation of knowledge itself ([Hyland, 2009](#)). As [Kobayashi et al. \(2017\)](#) suggested, students are able to enter the academic discourse community using each other for support, checks and knowledge construction. Socialization is after all a two-way process ([Duff, 2010](#), p. 168) where all 'have a joint responsibility to serve as better agents of one another's socialization and development.'

From the point of view of [Wenger \(1998\)](#), novices are at the periphery of the academic community and by interacting with more knowledgeable peers and experts they move to the center, in the end becoming experts themselves. However, the results of this study underline [Friedman's \(2021\)](#) and [Zappa-Hollman and Duff's \(2015\)](#) perspective on the importance of peers with similar backgrounds, concerns and goals for the socialization process. Socialization appears to be a process not only achieved through interacting with more knowledgeable others but also, at least partly, by interacting with like-minded peers of comparable levels of expertise.

In addition, students used their newly acquired academic framework in their everyday context in both a practical sense, by providing colleagues with tips and tools, and in a more fundamental sense, by contrasting the discourse of their professional context with academic discourse, in some cases leading to friction.

This aligns with the notion that learning is an inherently social process and that value created in a network has consequences for stakeholders or members from other networks than the learner's. Engeström and Glăveanu (2012) explained these tensions in his activity theory: when two activity systems meet, tensions between these systems occur, which results in learning potential but can also lead to resistance or conflict. In our study, this becomes evident when students talk about academic knowledge and academic habits of thinking while participating in the activity systems of their own professional contexts. Their colleagues, often educational professionals, are stakeholders and are as such influenced by socialization processes elsewhere.

Considering the indegree measures and the results of both inductive and deductive coding, there appears to be a relation between the learning ties students maintain and their academic socialization. More incoming learning ties corresponds with less reports on serendipity as mechanism for the construction of learning relationships, and more reports on resonance, academic interaction, academic socialization and utilization of knowledge. As Friedman (2021) indicates, expertise is fluid across situations and even within interactions. Resonance can be considered a more refined mechanism for the construction of learning ties than serendipity, since it requires agency and the ability to recognize and connect with suitable peers, whose general level of expertise might be comparable to the student's, but whose situational expertise is complementary to the student's learning needs. In a context of online education, in which coincidental encounters are scarce and serendipitous constructing learning relationships is more difficult than in face-to-face settings (cf. Olshannikova et al., 2020), resonance might not only be more refined, but also the only option.

Both the use of resonance and more incoming ties might indicate a greater skill in forming and maintaining learning ties. Since peers appeared to be relevant in students' academic discourse socialization, a higher ability to find and connect with suitable peers, could facilitate and stimulate more in depth discussions on course content and collaborative explorations of academic habits of thinking, leading to more reports on academic interaction, academic socialization and utilization of knowledge.

Resonance as a mechanism for forming learning ties appears to be comparable to the concept of 'network intentionality' (Moolenaar et al., 2014; Nardi et al., 2002), which refers to agency in forming, maintaining, and dissolving relations for the mutual benefit of oneself and others. Moolenaar et al. (2014) indicate individuals likely have varying degrees of intentionality in connecting with others and they associate being intentionally involved in social relationships with a greater involvement in educational innovation. The greater network skill some students appeared to display, showed a similar association with a greater involvement in academic socialization processes.

This study indicates that the constructing ties serendipitously is not always sufficient for the construction of a suitable individual learning network in distance education. When learning needs are not met by existing ties, the construction of such a network requires certain skills, such as students' recognition of their own learning needs, the ability to effectively communicate those needs to others and to intentionally connect with peers who have the situational expertise to meet those needs. This combination of skills could be described as *network literacy*. Although the results of this study have to be interpreted with caution, stimulating the development of students' network literacy in higher education could benefit their academic socialization. Since coincidental encounters of suitable peers are scarce online (Olshannikova et al., 2020), stimulating network literacy could be of special importance for distance education students, whose socialization processes are affected by the possibilities the online environment provide.

4.1. Limitations and implications

Although providing insights into how students use their informal learning networks, this work has limitations that suggest caution and more study. The SNA performed in this study contains missing values of students who did not participate, which may have influenced the degree measurements. Students like Frankie and Charlotte who in M2 appeared to have lost the incoming connections they had in M1, may have formed a learning source for students not participating in the study. According to the SNA, a few students did not report any valuable learning relationships, whether this includes incoming learning relationships is unclear. Two of these students were asked to participate in an interview, but refused. This may also influence the results of this study. The indication of a possible relation between incoming learning ties and academic socialization processes is based on a limited number of interviews and should be further explored in future research among a broader group of students.

Another limitation of our understanding of learning networks and their characteristics results from the availability of communication channels with affordances for communication and interaction which students might be using outside of the university learning environment. Since students were free to choose their own means of communication apart from the ones offered in the course, we know little about student interactions in such environments and its impact on network forming and development processes.

Because the course in this study is the first one of a Master's program, this research covered only a small part of a much longer process of academic socialization. Following students and the process of network development across curriculum up to the final trajectory of thesis writing can enlarge and deepen our understanding of the informal learning networks and its relation with academic socialization. These socialization processes can have other characteristics than found in network forming between experts or might be very different at the end of the Master's program. Further research should be conducted to explore the nature between network literacy and academic socialization processes.

Finally, perhaps both learning network creation and academic socialization would have been different if the networks had been actively coached by the course teachers, instead of merely facilitating network forming by the creation of awareness, ability and appreciation. However, this primarily facilitative and labor-intensive approach to stimulating networked learning resulted in informal student networks, in which students could practice with each other and through which they socialized each other in academic discourse.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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