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The impact of teacher's social network position on innovative work behaviour and the implementation of innovations, in international school settings.

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Abstract

Teachers contributions to innovations play a key role in whether or not an innovation is considered a success or a failure (Sharma, 2011).

This research sought to investigate to what extent a teacher's innovator categorization affects the successful implementation of an innovation. Teacher's innovator categories were determined by their innovative work behaviour through the use of a cluster analysis, and a social network analysis. Linear regression was carried out to explore whether social network position could explain the differences that exist between the categories. The research was cross sectional and quantitative, and 41 teacher's across three different international schools participated.

The findings of the research indicated that five different innovator categories could be defined using the innovative work behaviour (IWB) of teachers, and some of the categories shared similarities with the five adopter categories defined by Rogers. However, no aspect of social network position (in relation to advice, sharing new ideas, who was considered an innovator and who was considered a traditionalist), was significant in explaining the differences that exist between the innovator categories.

Possibilities for future research and recommendations, such as the inclusion of student data, and the investigation of external factors such as geographical location are discussed.

The impact of teacher's social network position and innovative work behaviour on implementation of innovations, in international school settings.

Rapid economic development and technological advances over the past century have led to changes in how people currently live. With change comes challenge, and as a result many organizations have been required to adapt and evolve. Lifelong learning skills such as collaboration and problem solving are now essential to competently participate in today's global workforce (Tucker, 2014). Formal education plays a key role in preparing today's global citizens with such skills. Traditional teaching methods are not adequately providing well equipped professionals for today's fast paced job market (Bringle & Hatcher, 1999). Therefore, innovation within the educational sector is essential to bring about the necessary change (Mishra & Kereluik, 2011). Essentially, changes are needed with regards to methods, resources and practices to bridge the gap between what schools provide and what the current working environment demands (Buregheh, Rowley & Sambrook, 2009).

Attempts to innovate are omnipresent in education today (Admiraal et al. 2017; Sidorkin & Warford, 2017). An example is blended learning, whereby traditional classroom methods and online digital media are integrated to deliver the curriculum (Halverson, Spring, Huyett, Henrie & Graham, 2007). Another is flipping the classroom which introduces instructional material prior to the lesson, allowing students more time to apply new knowledge and understanding under the guidance of the teacher (Mc Laughlin et al. 2014). However, the development of innovations is not enough to constitute real change. In order to take effect, key stakeholders need to successfully adopt and implement the innovation. Heuske and Guenther (2015) describes how the targeted adopters of innovations have the power to threaten or benefit an organization, highlighting their importance in the process. Within the educational sector, school boards, school leaders and teachers are responsible for the successful adoption and implementation of innovations. Teachers play a particularly prominent

role in the success or failure of innovations (Sharma, 2001), spending on average 718 hours per school year with the students (The Organization for Economic Cooperation and Development OECD, 2014). This puts them in the strongest position to exert influence on whether an innovation has an impact on student outcomes.

Ideally, well thought out innovations would involve and be accepted by teachers, and actively put into effect by all staff in a timely manner. While many attempts to innovate are occurring in schools worldwide, the progression from the adoption of, to the implementation of innovations remains a challenge (Hung, Jamaludin & Toh, 2015). For example, the No Child Left Behind [NCLB] and GOALS 2000 initiatives, implemented in the United states, failed to reach any of their goals. Houston (2007) states that the failure of the programs was due to lack of communication to and among teachers, regarding the innovations. Messmann and Mulder (2012) offer another perspective, stating that triggering innovative work behaviour (IWB) among teachers is necessary if innovations are to be successfully implemented and sustained. IWB is the process of generating innovative ideas, promoting them and being actively involved in realizing these ideas (Kanter, 1988; Messmann & Mulder, 2012). Geijsel, Sleegers, Van den Berg and Kelchtermans (2001) support this view, stating that such an approach eliminates teachers as mere users of an innovation, and instead provides them with ownership of the idea. Ownership often leads to increased efforts and commitment to ensuring the success of the idea (Pierce, O'Driscoll & Coghlan, 2004).

Rogers (2003) recognizes that individuals adopt innovations at their own pace rather than collectively at the same time, which he refers to as the adoption rate. The adoption rate can vary greatly across social systems and can occur almost immediately for some employees and take a great length of time for others. Rogers (2003) identified

five adopter categories; innovators, early adopters, early majority, late majority and laggards.

Position in the social network among targeted adopters, has been identified as playing a key role in the successful implementation of innovations (Rogers 2003; Hakkarainen, Palonen, Paavola & Lehtinen, 2004; Valente, Palinkas, Czaja, Chu & Brown, 2015). Social networks allow for knowledge sharing and the development of professional competencies with regards to understanding and implementing an innovation (Hakkarainen et al., 2004) and triggering IWB (Anderson, De Dreu & Nijstad, 2004; Messmann & Mulder, 2012).

Although teacher resistance towards innovation has been identified as the largest contributing factor to innovations not progressing beyond adoption in schools (Terhart, 2013), scientific research in this field is minimal (Sharma, 2001; Geijsel et al., 2001). Therefore, there is a need for better insight into the contributing factors that influence the rate at which teachers innovate. Based on this, the goal of this study is to determine whether different groups of innovators exist among teachers, with a focus on the role of social network position. It can be expected that teachers differ in the pace at which they diffuse innovations, ranging from those who innovate immediately to those who greatly resist. Moreover, IWB can help define the innovator categories that exist among teachers, and how well they are connected within their schools social network could potentially explain the differences that exist between categories. Research has shown (Tsai, 2001; Rodriquez & Alonso, 2013) that successful innovation relies on knowledge distribution and individuals who are central in the network with a larger number of connections are more likely to successfully implement innovations. Lynn, Muzellec, Cammerer, Turley, and Wuerdinger (2014), also suggest that early adopters of an innovation who have a prominent role in a social network could potentially attract

the interest of a late adopter to come on board at an earlier stage, again highlighting social networks as a noteworthy factor in research surrounding innovation implementation.

Theoretical framework

This section of the paper discusses the various concepts that are the focus of the study. First, innovation as a general concept is broadly defined. Second, innovation is more narrowly defined within the context of education and some concrete examples are provided. Next, the concept of IWB is defined. A detailed description of each of the adopter categories follows, with particular emphasis on the social behaviour that members of each category are likely to exhibit. Next the concept of IWB is defined. Finally, the concept of teacher's social networks are defined. Throughout, the relation between the key variables are continuously discussed.

Innovation

The definition of innovation is under constant debate considering the wide range of contexts it is applied to, and the differing views of scholars. Barnett (1953) for example, claims that a thought or behaviour that is new, in that it differs from existing forms, is an innovation. Rogers (2003), supported by Hueske and Guenther (2015), define new as being perceived as new by the targeted adopters. This means that an innovation can still be considered new by an organization, even if it is widespread elsewhere. For example, in 2008 more than 70% of primary and secondary schools in the United Kingdom were using interactive whiteboards, compared to 16% in the United States. Interactive whiteboards were considered to be a new innovation in the United States much later than in the United Kingdom ("Interactive whiteboards," 2018) . Bell (1963, as citied by Midgley & Dowling, 1978) sets out a clear criterion for an idea qualifying as an innovation, stating ten percent of the people within the social system at which it is

aimed must firstly accept the idea. As the definition of innovation has evolved, more and more emphasis is placed on the benefits of implementing an innovation for the organization adopting it (West & Anderson, 1996; Antonelli & Fassio, 2015).

It is important to note that the exploration of innovation in relation to human behaviour has been relatively slow (West & Altink, 1996) and so a consensus on a definition on innovation within this context is yet to be reached. However, there is a general concurrence among authors (Steyaert, Bouwen & van Looy, 1996; West & Altink, 1996) that innovation is indeed a socially constructed event based on interactions. Anderson & King (1993) state that innovations are constantly redeveloped and move towards implementation through interpersonal discussions, highlighting social participation as a key factor in relation to innovations.

Innovation in education

New ideas and concepts related to education are developing rapidly and the introduction of new tools, courses and practices into educational institutes, is abundant. While many of these ideas are often perceived as highly innovative, the mere incorporation of a tool or method, does not necessarily constitute as an innovation. For example, the use of iPads in classrooms to replace existing resources such as dictionaries cannot be considered a true innovation. Only when iPads are regularly used to do something that would not otherwise be possible to improve student learning (Murray & Olcese,2011), can they be described as an innovation.

Innovation in education can therefore be defined as an idea that causes a meaningful change in teaching and learning, with particular emphasis on improving the outcomes of students (Vincent-Lancrin, 2014; Serdyukov, 2017). These innovations can be generated within the institute or can be brought in from outside. Such innovations can include mobile learning, the use of data to inform decision-making and

inquiry based learning through the use of remote labs. These educational changes can be considered innovative since they all strive towards improving learning outcomes (Mishra & Kereluik, 2011). Through the use of these educational innovations, learning becomes more widely available (mobile learning), decisions become more student centered (data use) and more authentic tools are used to increase conceptual understanding (remote labs). However, innovations are only deemed successful when they continue to sustain student improvement (Mc Cormick, Steckler & McLeroy,1995) and this is only possible if school leaders and teachers implement them consistently and effectively.

Innovative work behaviour (IWB)

IWB is defined as the contribution that individuals make to the advancement of innovations in the workplace (Messmann & Mulder, 2012). Kanter (1988), established three core elements that constitute IWB. First, recognition of a problem and development of a solution must occur. Second, the promotion of and gathering of support for the idea needs to be established. Last, a model of the innovation that can be experienced needs to be implemented. Messmann and Mulder (2012) refer to five dimensions of IWB known as opportunity exploration, idea generation, idea promotion, idea realisation and reflection. Opportunity exploration refers to recognizing the problem and creating the opportunity to make changes or improvements. Ideas during the generation stage can be new, or existing ideas that are relevant to the problem or opportunity. Idea promotion involves networking with members of the organization to generate information, resources and support surrounding the innovation. Idea realisation involves piloting a prototype that looks at continuously improving the idea, as well as developing a plan to successfully integrate the innovation into the organisation. Finally, reflection focuses on assessing the progress of the innovation.

While earlier studies of IWB focused on the exploration and generation of ideas (Van de Ven,1986; Scott & Bruce, 1994), more recent literature places emphasis on the implementation of the innovations (Mumford & Moertl, 2003; De Jong & Den Hartog, 2010; Messmann & Mulder, 2012). Baer (2012) recognises the importance of distinguishing between the generation and implementation phases, pointing out that having creative ideas does not necessarily mean they will be implemented.

Baer's (2012) study reveals skilled networking as a positive trait, possessed by employees who can drive an innovation to the implementation stage. Skilled networking is a trait often attributed to the early adopters of an innovation (Rogers, 2013; Fraser, 2013). Janssen (2003) challenges this idea, suggesting that employees who push for change often meet with conflict across their social networks, particularly with those who resist change, often referred to as laggards (Rogers, 2013). Duffy, Scott, Shih and Susanto (2011) strongly support this argument, stating that IWB has a positive relation with conflict with co-workers. Overall, there are clear indications in literature that a relation between social networks in organisations and IWB exists. (Anderson, de Dreu & Nijstad, 2004; Baer, 2012; Janssen, 2003). Individual members of organisations display varying levels of IWB, meaning that not everyone is equally innovative. Some people are open towards innovative ideas and implementing them, and others are less so. Messmann and Mulder (2012) argue that IWB can be triggered. This can be achieved through social interactions among the network (Anderson, De Dreu & Nijstad, 2004), which can impact the rate at which members of the organisation on-board the innovation.

Adoption and diffusion-adopter categories

Innovation adoption is described by Rogers (2003) as a decision making process. The process usually begins with the recognition that a need for change or improvement

exists. Following this, possible solutions are explored and the decision to attempt to adopt one of these is made, which reflect the early stages of IWB as described by Messmann and Mulder (2012). Finally an actual attempt to adopt and implement the solution is made, resulting in either the rejection of or acceptance of the innovation by the targeted adoption audience (Mendel, Meredith, Scheonbaum, Sherbourne & Wells, 2008; Damanpour & Scneider, 2006). Diffusion of an innovation is the process by which an innovation is communicated to the members of a social system. Diffusion is considered social in nature as meaning is often given to the innovation through interpersonal communications (Rogers, 2003; Lyytinen & Damsgaard, 2001; Compagni, Mele & Ravasi, 2015).

Rogers (2003) refers to the different stages at which people adopt an innovation after it has been introduced as the rate of adoption. As illustrated in Figure 1 (Rogers 2003, p. 128), the diffusion of innovations follows a bell shaped curve when plotted over time, and therefore is described as having normal distribution. Despite having normal distribution, Rogers developed five adopter categories to allow for the comparison of the rate of adoption. This subsequently helps identify characteristics, such as social interaction, that contribute to the success or failure of an innovation. The following summaries provide a useful insight into the expected social behaviour of each of Rogers (2003) adopter categories.

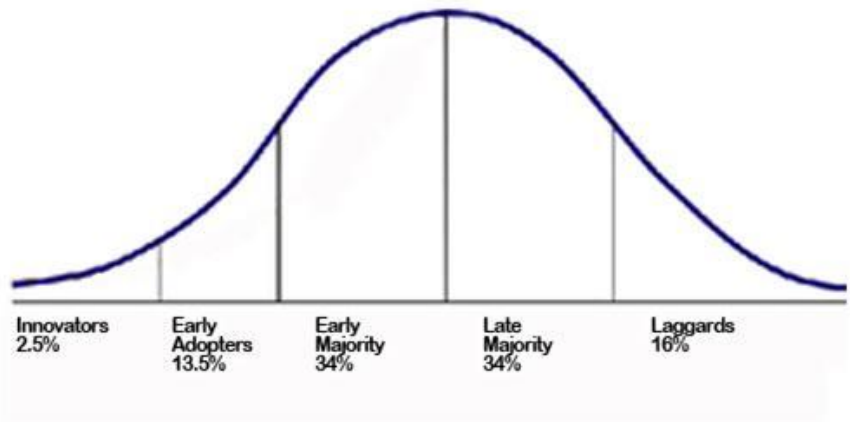


Figure 1. Normal distribution curve of diffusion of innovations. Reprinted from Diffusion of Innovations (p.128) by E. Rogers, 2003, New York, NY: Free Press.

Innovators. The first 2.5% of the population are described as innovators or the gatekeepers (Rogers 2003). Jacobsen (1999) states that they usually form relationships outside of the social system, due to their interest in new ideas, and as a result may not always receive the respect of their peers.

Early adopters. Unlike innovators, the early adopters who make up the next 13.5% of the population, are viewed as role models. These key actors often have a central role within the social network and act as leaders for the adoption of the innovation. Usually, early adopters are respected by their peers and are asked for advice and information (Jacobsen, 1999).

Early majority. 34% of the population are known as the early majority. Although these actors interact regularly with their peers, they are not described as leaders (Elgort, 2005). The early majority play an important role in connecting members of the social system due to their position between early adopters and late majority (Rogers, 2003).

Late majority. The late majority make up 34% and usually adopt an innovation when most of the uncertainty has been removed. They generally seek advice from the

early majority and rely on their endorsement of the innovation (Jacobsen,1999). The late majority are often seen as adopting an innovation as a result of continued peer pressure (Rogers, 2003).

Laggards. Laggards represent 16% of the population and are last to adopt the innovation. Laggards are often isolated from the social system and when social participation does occur, it is usually with peers who share their opinion (Rogers, 2003) which can prolong their decision to adopt the innovation in question.

It is purposed that the category to which members of organisations belong to depends on their social network position. Therefore this research will identify the different innovator categories that teachers belong to and investigate the extent to which their position in their network influences the category to which they belong.

Social network position

A social network can be defined as the social ties that are developed within a particular social system (Moolenaar, 2012) and centrality is an important variable in relation to social networks.

Centrality is defined as the number of relationships individuals maintain within their social network (Moolenaar, 2012). More connections and interactions with individuals within a social network can lead to timely diffusion of an innovation, as actors have more information due to communication with a wider pool of individuals (Bjork & Magnusson, 2009; Moolenaar, 2012). Moreover, research (Becker, 1970; Bjork & Magnusson, 2009; Aktamov & Zhao, 2014) has consistently shown that members of a network who display high centrality are often opinion leaders, and are therefore more likely to be early adopters of an innovation.

The position of actors within a social network, can greatly influence whether an innovation succeeds or fails as more connections and interactions among actors is

likely to lead to more information, resources and support surrounding the innovation (Moolenaar, 2012; Valente, 1995). Rogers (2003) believes that each of the five adopter categories display certain behaviours that influence their position within the social network. For example, the early majority are likely to interact with both early adopters and late adopters, and act as a tie between them, while laggards primarily interact with other laggards (Steele & Murray, 2004). Figure 2 depicts a simple sociogram, and shows Diana to have high centrality. It would therefore be expected that Diana would be an early adopter of an innovation. On the other hand, it is likely that Winston would be part of the late majority. Although his centrality is low, he interacts with Diana rather than laggards, which could potentially influence the rate at which he adopts an innovation.

Studies have shown that network position and IWB are closely linked (Zhou & Shalley, 2003; De Jong & Den Hartog, 2010), and employees with high levels of IWB tend to be central in their networks. Employees with high centrality are typically open towards others and readily share their new ideas (Sulistiawan, Herachwati, Permatasari and Alfridaus, 2018). This often leads such employees to having a high level of interaction with their peers, and therefore a central position within the network can be established. While personality traits and educational level of employees, has been offered as an explanation for differing levels of IWB and social network position (Ahmed, 1998), studies have shown that job context is also a key factor (Lambriex-Schmitz, Van der Klink & Segers, 2017; Storen, 2016). For example, since teachers often feel excluded from the decision making processes that occur in their schools, (Nemerzitski & Loogma, 2017), less professional social networking and lower levels of IWB may exist in educational contexts.

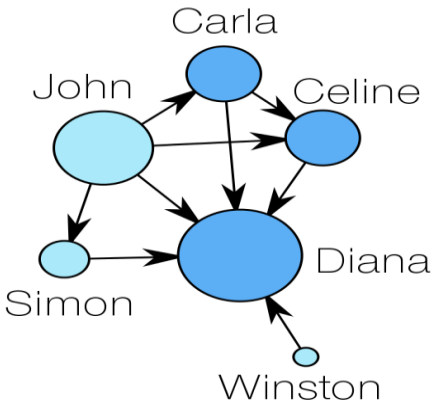


Figure 2. A simple sociogram demonstrating in-degree centrality

Research question and model

Roger's theory of diffusion is widely utilized in social research. A number of measurable characteristics such as socio-economic status, communication behaviour and personality values (Rogers, 2003, p. 251) have been developed. Yet they are often addressed collectively. The research described in this paper will focus on one important aspect of networks:centrality. IWB is used as an indicator of innovativeness and Roger's theory of diffusion, with particular emphasis on the five adopter categories is used as a framework.

This paper focuses on teachers working in schools in an international context and raises the following research questions;

Can the innovator categories as described by Rogers be identified based on teachers' innovative work behaviour ?

If so,

how are differences between these innovator categories explained by their position in the social network?

Method

Research Design

The goal of this study is to determine whether a teacher's position in the school's social network impacts the rate at which individual teachers adopt or reject an innovation. The research is cross-sectional and quantitative. A non-experimental design in the form of a survey is used to gather the data. The survey is distributed electronically as this is the most likely format to yield high response rates from a large number of respondents who are geographically dispersed (Boudah, 2010).

Respondents

The current study aimed at gathering data on the individual level. The population of focus was teachers and leaders in international contexts. Convenience sampling was used as the method to gather respondents as it is both affordable and subjects are readily available (Etikan, Musa & Alkassim, 2015). More specifically, international schools worldwide were approached via email, their contact details were available via personal contacts of the members of the research team or via school websites. Due to the fact that the study required whole school participation, as well as asking questions that required the identification of colleagues via their name, a low response rate and drop outs were expected. In addition to these requirements, the following three criterion, as set out by Hill (2000) were applied in order to define international schools. First, students and staff should come from a wide and varying background. Second, the schools should offer the International Baccalaureate or a variety of national curricula, and finally the schools should also have an ethos of internationalism. In total, six schools agreed to the distribution of the survey among their staff, however, the survey was voluntary and a minimum of 50% response rate is recommended (Moolenaar, 2012) when carrying out such a study. After conducting the data collection over a four week period, that

included two reminders, three schools were removed due to a low response rate. The remaining three schools had response rates of 37% (School A), 56% (School B) and 57% (School C) respectively and were situated in The USA and Malawi.

A total of 45 teachers participated in the study of which 13 were males and 32 were females. Their age ranged from 25-65 years. More than half of the teachers (53.3%), hold a masters degree level of education and 42% a bachelor degree. The experience of the teachers in the educational sector ranged from two years to 42 years, with the majority (89%) having more than ten years experience.

Instrumentation

In order to gather data for this research, one comprehensive questionnaire was compiled, to help determine the IWB that individual teacher's display, their position in the social network and the impact of these factors on the rate at which innovations are adopted. The questionnaire was made up of two distinct sections, which are elaborated on below. Qualtrics research software was used to create, distribute and collect the data. Before distribution, necessary changes for the various different schools were made. For example, subjects taught were modified based on the different curricula that each school used, and the names of staff members were also changed to correspond with the individual schools.

IWB. This section of the questionnaire measured the IWB of respondents. More specifically, the individual contributions that each teacher has made to the five innovation tasks. IWB was measured using an adapted version of the validated and reliable instrument designed by Mulder and Messmann (2012). The adaptation came in the form of a translation from German to English, and was carried out by Messmann and Mulder, who created the questionnaire. The instrument is composed of two distinct parts. The first part consists of 24 multiple choice questions, which are essentially work

activities that need to be carried out to effectively realize four of the innovation tasks; opportunity exploration, idea generation, idea promotion and idea realisation. The frequency at which they were carried out were indicated on a 6 point Likert scale ranging from 1 (never) to 6 (very often). Example items related to opportunity exploration are, “keeping up with the latest developments in the organisation,” and “exchanging information about recent developments and problems at work with colleagues.’’ Idea generation examples are, “expressing new ideas on how to solve a problem at work,” and, “ asking critical questions about the current situation at work.’’ Idea promotion include examples such as, “convincing others of the importance of a new idea or solution,” and “addressing key persons who are in charge of necessary permissions or resources.” Finally, example items of idea realisation are, “critically examining one’s own procedure during the realisation of an idea,” and “thinking carefully about the goals that should be attained through the realisation of an idea.”

The second part of the instrument asks participants to recall a recent episode of renewal or change, to ensure the measurement is context-bound and provide them with the opportunity to reflect (Bauer & Mulder, 2010). The section consists of five questions, four of which focus on the process of the innovation, and one goal orientated question. If participants were unable to recall a process of change or renewal that they were directly involved in over the past few months, they were not required to answer this section and were directed to the next part of the survey.

Social network analysis(SNA). SNA is a systematic investigation used to quantify and generate visibility of the ties and overall structure of formal and informal networks (Daly et al. 2009). Four questions made up the SNA section of the survey. The focus of the questions were; which colleagues did teachers discuss new ideas with, seek advice from, consider to be innovators and consider to be traditional in their

attitude towards teaching. Standard protocols for SNA, as recommended by Moolenaar (2012) were followed.

Post-hoc test. A post-hoc test using G*Power software was used to determine the statistical power of the test. The study revealed a statistical power of 0.3.

Procedure

The questionnaire was distributed to all teachers in the schools that agreed to participate, via Qualtrics software program. The questionnaire was accompanied by an email outlining the purpose of the research and the terms of participation.

Data Analysis

Social network position. The degree centrality for each case was calculated to determine each individual's position in the school's social network. The chosen measure was in-degree centrality, which was calculated using the answers provided by teachers to the social network questions, and analysed using UCINET 6.0. More specifically, Freeman's (1978) formulae was used. A teacher's in-degree centrality accounts for the number of individuals who identified him or her as an innovator, traditional in their thinking with regards to teaching methods, someone that is sought out to provide advice, and someone to discuss new ideas with. It is important to note that in-degree centrality is an asymmetric measure, meaning that the direction of the tie (who identified who), is taken into consideration (Moolenaar, Daly & Sleegers, 2010).

Innovator categories. Despite finding univariate distribution, a cluster analysis was used to determine whether innovator categories exist among teachers in each school. Cluster analysis identifies homogeneous groups of objects that share characteristics but are very dissimilar to objects not belonging to the cluster. In this case, the similarity of teacher's IWB was calculated. For the purpose of this study, agglomerative hierarchical clustering was selected, which merges clusters together one

at a time in a series of sequential steps (Blei & Lafferty, 2009). Hierarchical clustering was deemed most appropriate in this case, considering the small data set (N=45), and it allows for easy examination of solutions with increasing numbers of solutions. The similarity of cases is calculated by estimating the distance between pairs of objects. After close examination of all measurement distances, squared euclidean distance was selected, as it is most suitable for continuous variables (Everitt,1987), such as in-degree centrality and is recommended by SPSS specifically for Ward's method. Ward's method was selected as the method of clustering, as it has performed significantly better than other clustering procedures with regards to realistic interpretation of clusters (Blashfield, 1976; Hands & Everitt, 1987) It is also of particular use with the small dataset from this study as it minimizes the variance within the groups (Everitt, Landau, Leese & Stahl, 2011). All 24 items related to IWB were used to determine the innovator categories as recommended by Messmann and Mulder (2012). This is due to the number of items used to measure the five constructs of IWB. For example only two are used for reflection, yet a more holistic overview is required for the purpose of this study. The hierarchical procedure was carried out using SPSS 25.0. and care was taken to validate the procedure using some of the guidelines as set out by Aldendefer & Blasfield (1984).

Predicting category differences. After defining the innovator categories using the IWB of the teachers, multiple linear regression was carried out to analyse how the categories differ from each other based on position in the social network. The in-degree centrality for each of the four social network question, derived from the UCINET 6.0 software, were used as the independent variables. The combined mean for all 24 IWB questions was the dependent variable. Initially, all four predictor variables were entered simultaneously into the model. This model therefore explains how much unique

variance the dependent variable, IWB, is explained by each of the four independent variables. Subsequently, the four predictor variables were investigated sequentially through the use of 'backward deletion' where at each step, the variable that will lead to the smallest (non-significant) decrease in model fit (Mundry & Nunn, 2009) was removed.

Results

The findings of this study are reported in three sections. Firstly, some descriptive statistics and correlations are presented. Next, the findings of a hierarchical clustering analysis are presented, to determine whether innovator categories, as described by Rogers (2003), can be identified based on teachers IWB. Finally, the results of a multiple regression analysis, to inspect whether a teacher's social network position can explain the differences that exist among the categories is presented.

Descriptives

Three different international schools; school A, school B, and school C participated in the study (N=45). As presented in Table 2, teachers in this study displayed high levels of IWB (M = 4.50; SD = .65). Few people were described as innovators by their colleagues (M = 1.42; SD = 1.41), and those who were considered innovators frequently received a nomination from only one colleague (38%). More teachers experienced their colleagues sharing new ideas with them (M = 4.42; SD = *3.22),* with almost a quarter of them (24%) having three colleagues share their new ideas with them. Notably, 38% of the teacher population received no nominations by colleagues for being traditional in their teaching methods. Pearson's correlation analysis was used to examine the relationship between the variables. As presented in Table 2, most of the correlations that exist among the variables are weak correlations.

Important to note is that, three of the centrality measures, new ideas (r = -.10), innovators (r = -.01), and traditionalist (r = -.05) are negatively correlated with IWB. This means that on average, a low score on IWB is likely to be accompanied by a low score on the three social network elements; new ideas, innovator and traditionalist.

Table 2

Three social network variables and IWB: Correlations and descriptive statistics (N = 45)

Variables	1	2	3	4	5
1. New ideas	-				
2. Advice	.19	-			
3. Innovators	-.24	.26	-		
4. Traditionalists	.11	.08	.14	-	
5. IWB	-.10	.20	-.01	-.05	
Mean	4.42	2.96	1.42	1.96	4.50
SD	3.22	2.65	1.41	2.74	.65

Note. IWB = Innovative work behaviour

Innovator categories

Hierarchical clustering analysis was used to help determine an answer to question one, regarding whether innovator categories based on Roger's adopter category model (2003), could be identified based on teachers' IWB. The identified clustering method was Ward's method, using squared euclidean distance as the selected distance measurement. Since all items were measured using the same 6 point likert scale, standardization was not a requirement. In order to obtain the optimal solution for the number of clusters that exists among the dataset, clustering with various numbers of groups were run. More specifically, to allow for realistic evaluation possibilities, solutions for three to seven clusters were tested and the following procedure to best

interpret the data, as recommended by Aldendefer and Blasfield (1984) was used. The coefficients output from the agglomeration schedule was used to generate a scree plot and determine the most appropriate cut off point in the dendogram. Considering cluster analyses are exploratory approaches, a visual criterion was used. Two differentiated regions were observed and the dendogram was cut at the knee of the scree plot. Both of Ward's four and five cluster solutions were deemed suitable. For the purpose of this study, the five cluster solution was selected, as it is the most appropriate considering Rogers (2003) model also identifies five categories within his model. Essentially, this means that all participants of the study were individually assigned to one of five clusters. Each has been assigned a colour to ensure identifying patterns and making comparisons is made easier.

Table 3 shows the mean scores for IWB of each of the clusters. These mean scores are used to match the five clusters established by Rogers (2003) to the five categories of this study as determined by the hierarchical cluster analysis. It is noteworthy that the lowest mean ($M = 3.50$) is relatively high, which may suggest that no real laggards exist in this network. This indicates that Roger's model does not entirely fit the cluster model that was generated based on teacher's IWB.

Table 3.

A summary of the cluster numbers, assigned colour, the innovator category based on IWB mean score, number of cases per category and the distribution as a percentage.

Cluster number	Colour	Number of cases	IWB mean	Innovator category	Percentage
1	Orange	8	5.33	Innovators	17.7%
2	Green	12	4.90	Early adopters	26.6%
3	Yellow	6	4.63	Early majority	13.3%
4	Red	11	4.12	Late majority	24.4%
5	Blue	8	3.50	Laggards	17.7%

As illustrated in Figure 3, the distribution of the clusters as determined by teachers IWB, does not entirely match the bell-shaped curve that Roger's (2003) applied to the five categories he identified within his model. Despite this, Roger's model remains relevant to this study as the five categories Roger developed allowed for the identification of common social behaviours that members of the innovators, early adopters, early majority, late majority and laggards categories, exhibit. For example, early adopters are often asked for advice, while both early adopters and the early majority are most likely to have new ideas shared with them (Jacobsen, 1999; Rogers, 2003). Therefore, the social behaviour of the teachers within the three schools that participated, was inspected, to determine whether the clusters identified by teachers IWB showed any similarities to the social behaviours attributed to each of Roger's categories.

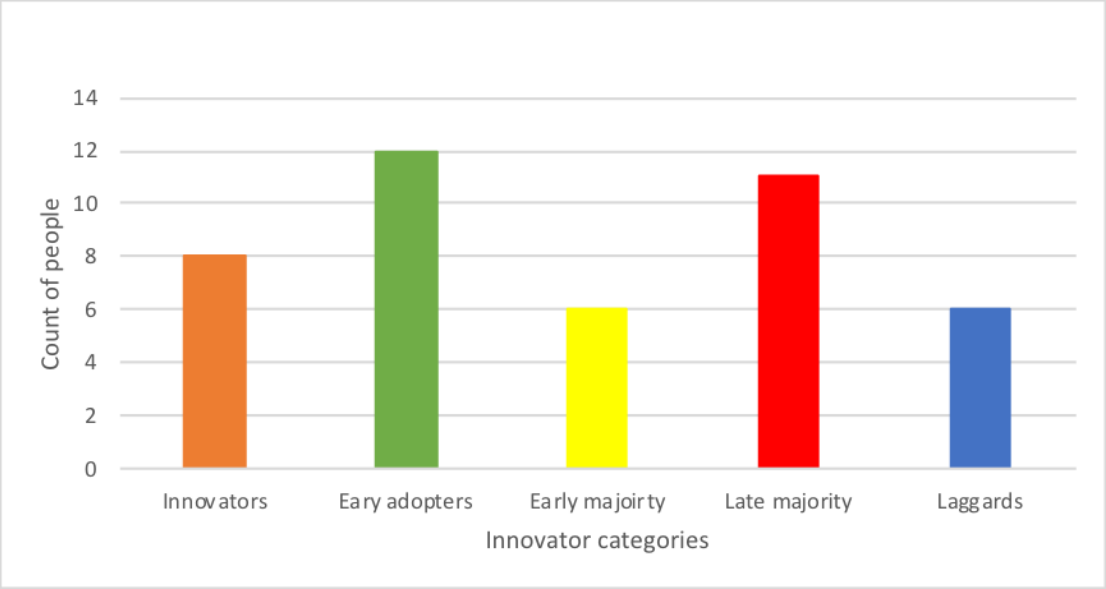


Figure 3.Distribution of clusters based on the hierarchical cluster analysis procedure

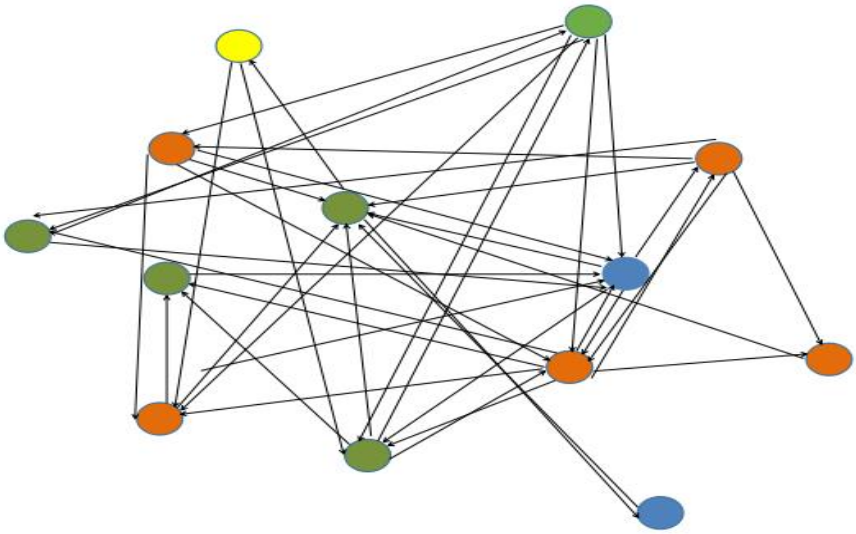
The 12 networks displayed across Figure 3, Figure 4, Figure 5 and Figure 6, are visualisations of the social behaviour of the teachers in each of the schools, school A, school B and school C. Figure 3 focuses on who the teachers within each network ask for advice, and Figure 4 focuses on who teachers share their new ideas with within the network. Figure 5 shows who teachers consider to be innovators within their school network and finally, Figure 6 shows who teachers think are traditional in their thinking. Each of the networks are individually examined and compared to the social behaviours that have been linked to the five categories. It is important to note that only four categories exist within School A.

Advice. Based on literature (Jacobsen, 1999; Rogers, 2003) it is expected that early adopters are most frequently asked for advice within a network, since they play a central role in connecting members of the social system. The mean IWB scores of this study, suggests that the green cluster ($M = 4.90$) represents the early adopters. Figure 3 confirms that in all three schools; school A, school B, and school C, members of the green cluster are frequently asked for advice, therefore supporting the expected

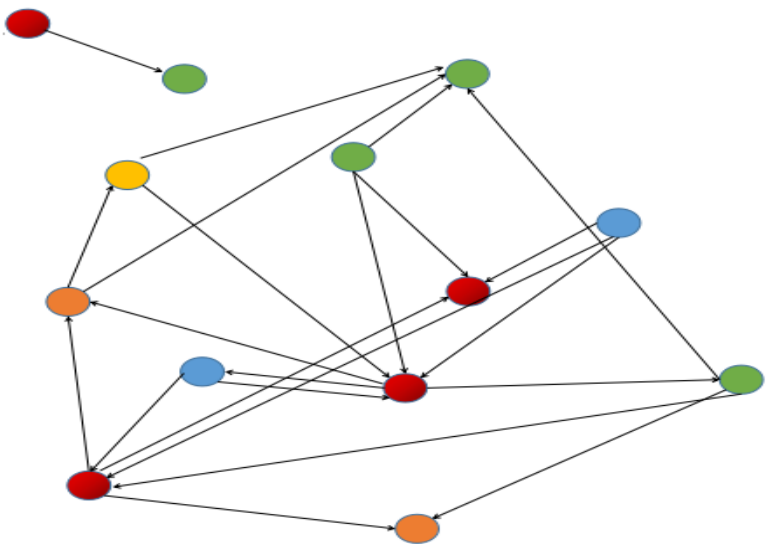
findings. However, both school B and school C show that members of the red cluster (*M* = 4.12) which represents the late majority are frequently asked for advice. These findings are contrary to literature which suggests that the late majority are known for following advice rather than giving advice (Egan, 2007).

Figure 3. Visualisation of the advice networks in school A, school B and school C.

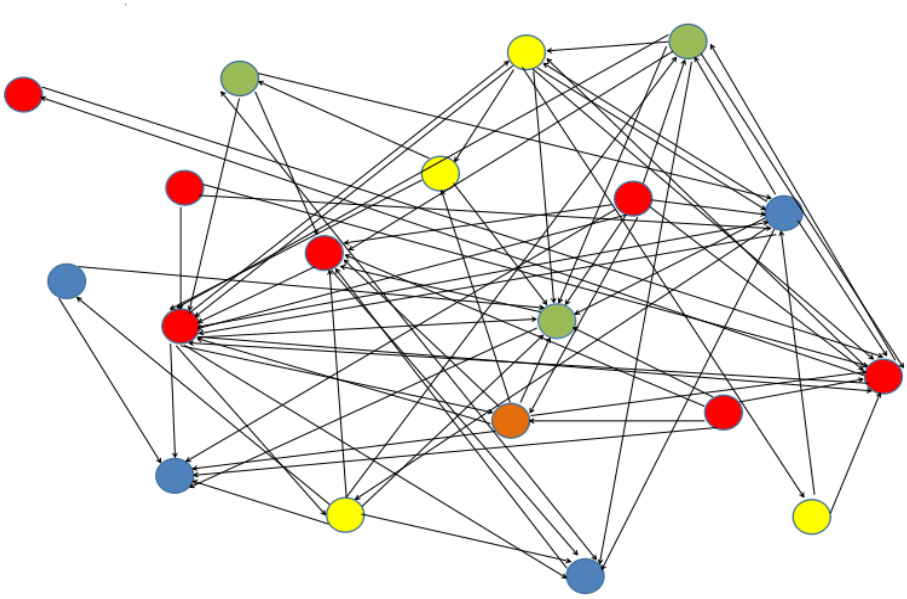
School A



School B



School C



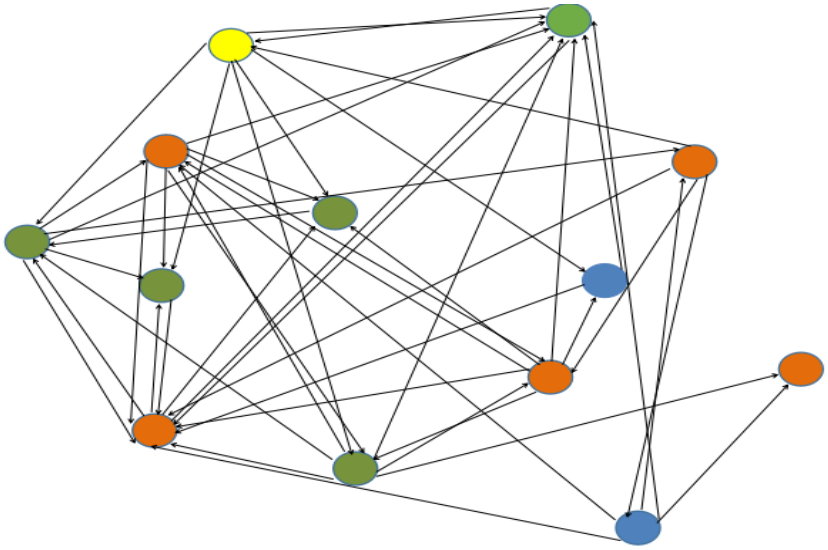
Note: Orange = innovators; green = early adopters; yellow = early majority; red = late majority; blue = laggards

New ideas. Although innovators are usually associated with having a high level of interest in new ideas, they are also known for forming relationships outside of the network (Rogers, 2003). It is therefore expected that only some members of the network share their new ideas with innovators. Due to early adopters being considered as opinion leaders and role models for their peers (Rogers, 2003), it is most likely that most people share their new ideas with them. Figure 4 confirms that in both school A and school B, indeed most people share their new ideas with the green cluster (*M* = 4.90), which represents the early adopters. A much higher number of ties to sharing new ideas with the orange cluster (*M* = 5.33) which represents the innovators, was present in school A compared to school B. School C contradicts the expected findings,

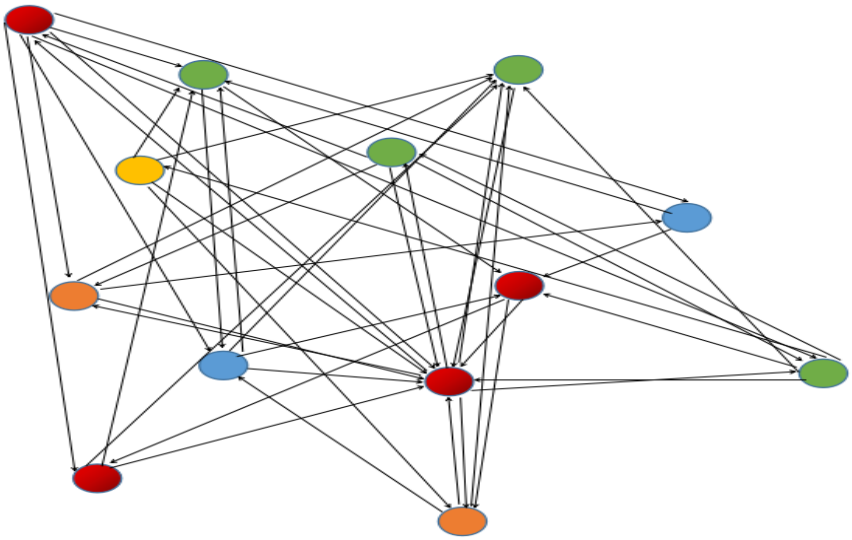
with members of the red cluster (*M* = 4.12), which represents the late majority, receiving the most nominations. A possible explanation is that the late majority are known for accepting peer innovations as a result of peer pressure (Rogers, 2003) and so more ideas are shared with them in attempts to on-board them at an earlier stage.

Figure 4. Visualisation of the new ideas networks in school A, school B and school C.

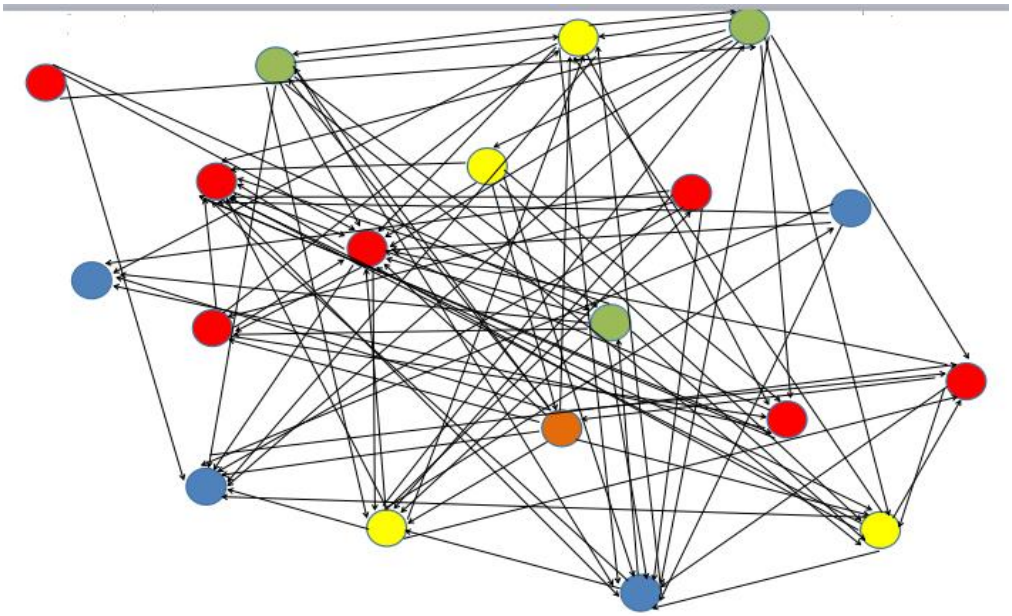
School A



School B



School C

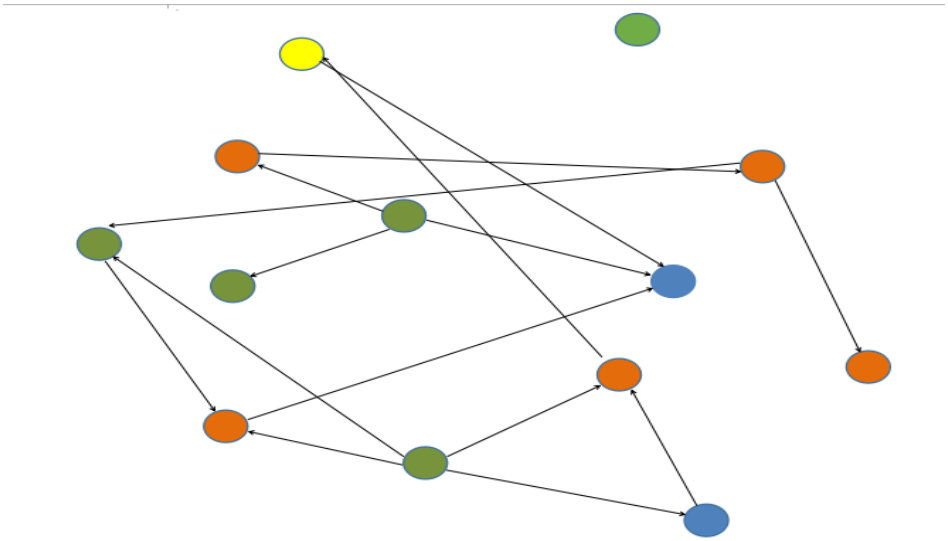


Note: Orange = innovators; green = early adopters; yellow = early majority; red = late majority; blue = laggards

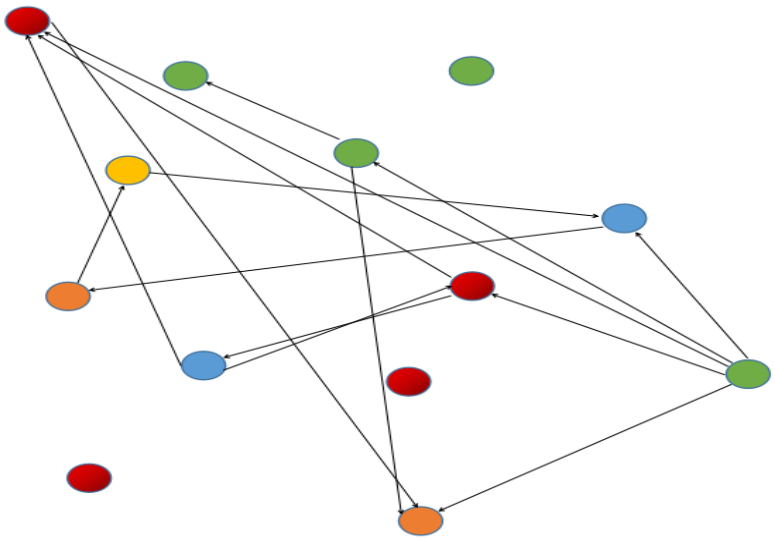
Innovators. According to IWB scores, members of the orange cluster (*M* = 5.33), are the innovators and therefore should be most frequently nominated by their peers. However, it is important to note that innovators are often disconnected from the network and do not always receive respect from their peers (Rogers, 2003). It is therefore possible that other members of the network find it difficult to identify them as they have little or no social contact within the network. In Figure 5, school A supports the expected findings, with the orange cluster receiving the most nominations. The green cluster (*M* = 4.90), which represents the early adopters also received numerous nominations within school A's network. School B's teachers also showed the orange and green cluster receiving the most nominations, which again, is in line with the expected outcomes. However, school C deviates from the expected outcomes and shows most teachers consider members of the yellow cluster (*M* = 4.63), which represents the early majority to be the most innovative.

Figure 5. Visualisation of the innovators networks in school A, school B and school C.

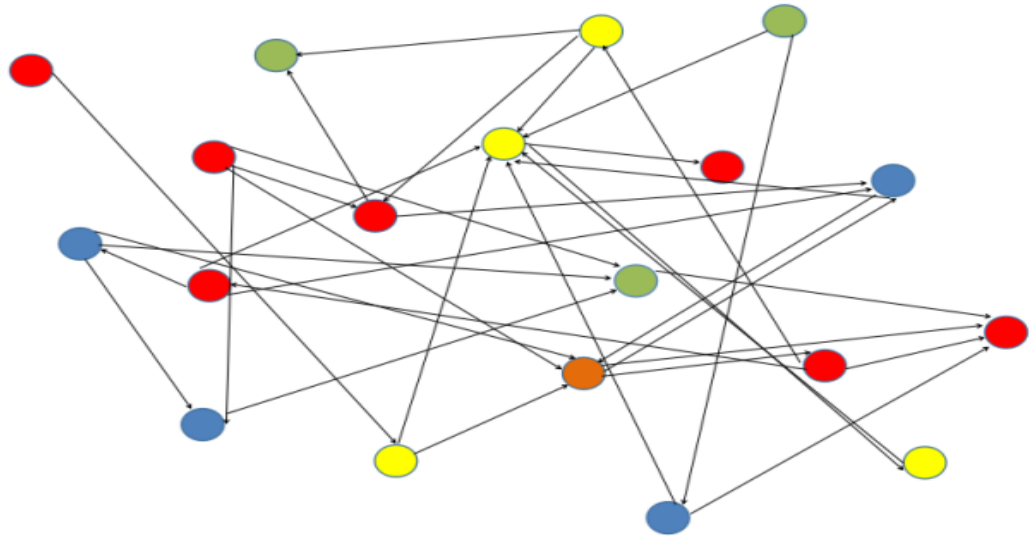
School A



School B



School C

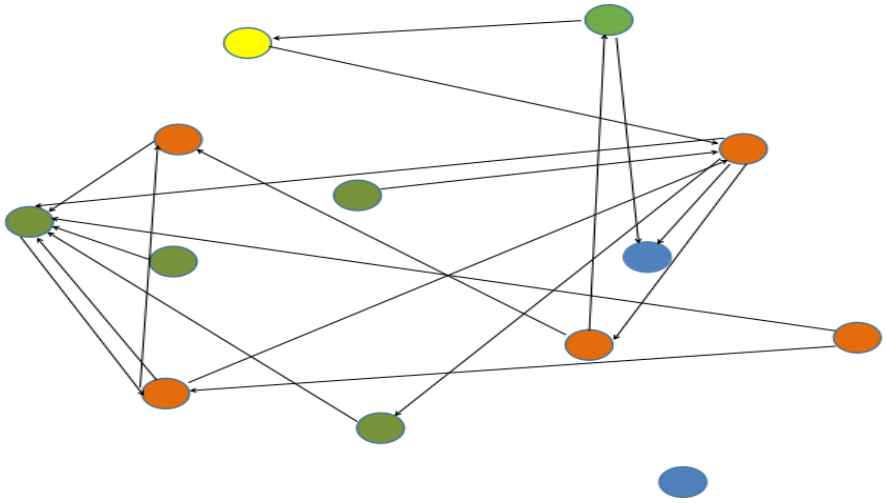


Note: Orange = innovators; green = early adopters; yellow = early majority; red = late majority; blue = laggards

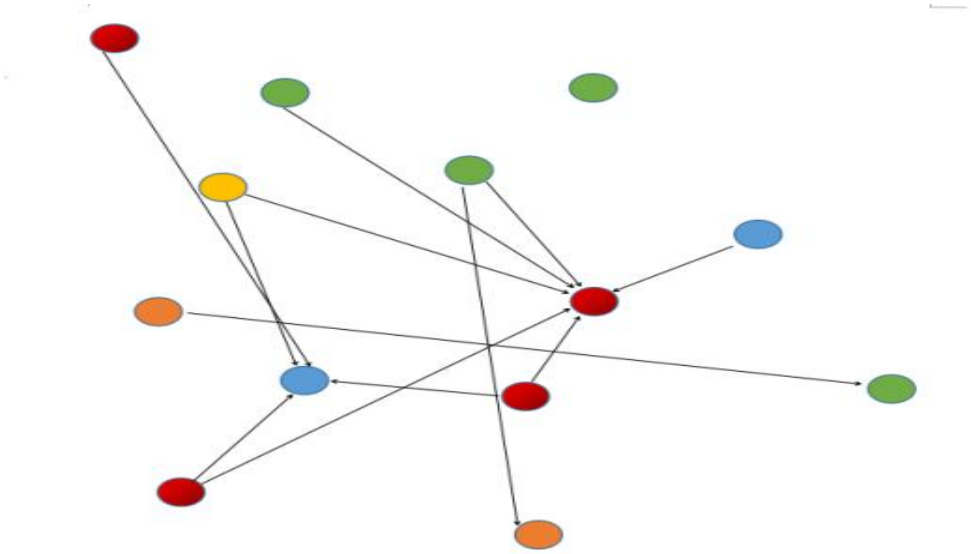
Traditionalists. With regards to traditionalists, it is expected that teachers who are members of the blue cluster (*M* = 3.50) will receive the most nominations as this cluster represents the laggards. Since the late majority are also considered to be quite resistant to change (Rogers, 2003), it is likely that the red cluster (*M* = 4.12) will also receive nominations from their peers for being traditional in their teaching methods. Both school B and school C support the expected results with mostly members of the red and blue clusters receiving nominations. However, school A deviates from the expected outcomes as the orange cluster (*M* = 5.33) and green cluster (*M* = 4.90) which represent the innovators and the early adopters respectively, received the most nominations. These findings are not in line with literature (Rogers, 2003; Jacobsen, 1999) that acknowledge innovative characteristics among innovators and the early adopters.

Figure 6. Visualisation of the traditionalist networks in school A, school B and school C.

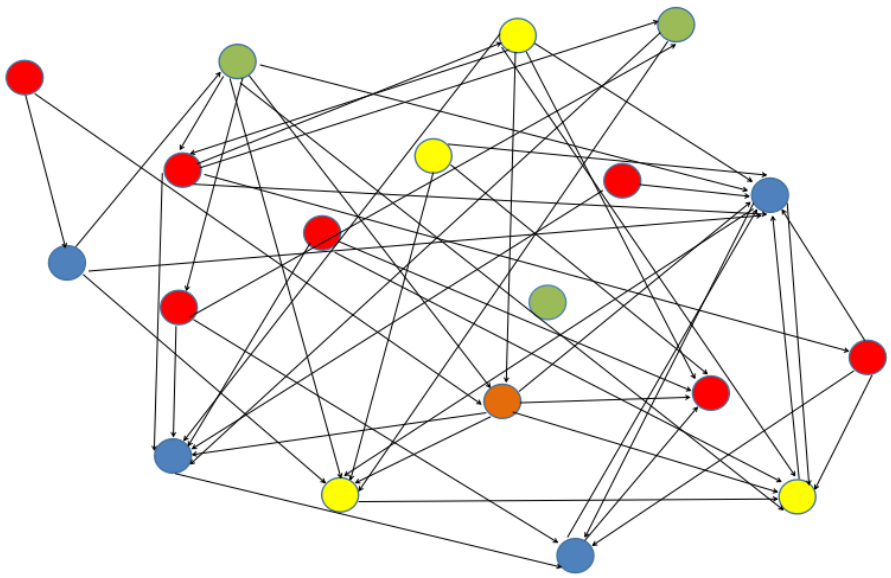
School A



School B



School C



Note: Orange = innovators; green = early adopters; yellow = early majority; red = late majority; blue = laggards

Overall, there are some clear similarities between the behaviours described by Rogers for the five adopter categories and the clusters that were identified in this study based on teachers IWB. The evidence supports some elements of the categorization of the five clusters based on the IWB mean scores. That is, members of the orange cluster show similarities to the social behaviour of Roger's innovators. This is also true of the green cluster, who clearly share behaviour attributed to the early adopters and the blue cluster sharing behaviour attributed to laggards. However, the red cluster cannot be considered to share behavioural attributes with the late majority. In this study, members of the red cluster saw people seek advice from them, considered them to be innovative and shared new ideas with them. Rogers does not attribute any of these behavioural characteristics to the late majority. A possible explanation is that no true laggards exist and therefore a four cluster model may have been a better fit.

In conclusion, the results indicate that IWB of teachers can be used to identify the innovator categories of teachers in international schools. While Roger's model proves

useful in helping to determine behavioural patterns among and between these innovator categories, the identified clusters based on social behaviour deviates from the model.

Category differences

Since categories were successfully identified based on teacher's IWB, the second question which addresses how the innovator categories are explained from each other based on their position in the social network can be investigated. Therefore, a multiple linear regression was calculated to determine the influence of the in-degree centrality of advice seeking, sharing new ideas, who is considered as the innovators and who is considered the traditionalists in teacher's social networks, on IWB. As shown in Table 4, the results of the regression analysis indicated that the four predictors explained (R^2 = .08, $F(4,40) = .85$, $p = .504$) 8% of the variance. Investigation of the parameters showed that none of the parameters, advice $b = .07$, $SE = .04$, $t\ (44) = 1.68$, $p = .101$, new ideas b = -.04, $SE = .04$, $t\ (44) = -1.12$, $p = .271$, innovators b = -.06, $SE = .08$, $t\ (44) = -.75$, $p = .836$, and traditionalists $b = -.01$, $SE = .04$, $t\ (44) = -.21$, $p = .836$ impacted on IWB. This means that the number of colleagues who sought advice, shared new ideas with you, considered you to be either an innovator or a traditionalist, had no influence on the IWB of the teachers in the networks of the three participating schools.

Table 4.

Multiple regression analysis with IWB mean as the dependent variable

Variable	*b*	SE *b*	β	*t*	*p*
constant	4.56	.22		20.50	<.001

Advice	.04	.27	1.68	.101
New ideas	.03	-.18	-1.12	.271
Innovators	.08	-.13	-.75	.460
Traditionalists	.04	-.03	-.21	.836

Note: R^2 = .08, $F(4,40)$ = .85

Considering the insignificant results backwards modelling was used to further inspect the data. The independent variable of those considered traditionalists was removed from the model, as this variable had the highest value of insignificance (p = .863). The multiple linear regression model was run again. The results of this regression analysis indicated that the three remaining predictors still explained (R^2 = .08, F (3,41) = 1.14, p = *.3.44)* 8% of the variance. Investigation of the parameters showed that none of the parameters, advice b = .67, *SE* = .04, t (44) = .27, p = .097, new ideas b = -.04, *SE* = .03, t (44) = -1.17, p = .249, innovators b = -.06, *SE* = .08, t (44) = -.80, p = .428, impacted on IWB. This means that whether only a few or many colleagues sought advice, shared new ideas with you, or considered you to be an innovator, had no influence on the IWB of the teachers in the networks of the three participating schools. Again, the independent variable that had the highest value of significance (p = .428), which was innovators in this case, was removed from the model, leaving only two independent variables, advice and new ideas. The results of this regression analysis indicated that the remaining predictors now explained (R^2 = .25, F (1,40) = 1.17, p = .257*)* 25% of the variance. Investigation of the parameters showed that the neither of the parameters advice b = 0.6, *SE* = .04, t (44) = 1.53, p = .134, or new ideas b = -.03, *SE* = .03, t (44) = -.98, p = .334 had any impact on IWB. As a last step, new ideas was removed, as it has the highest value of significance(p = .334) among the two remaining

variables and the regression model was run again. The results of the regression indicated that the remaining predictor now explained (R^2 = .20, F (1,43) = 1.86, p = .180) 20% of the variance. Investigation of the parameters showed that the parameter, advice b = .05, SE = .04, t (44) = 1.36, p = .180, did not have an impact on IWB. This means that whether few or many colleagues sought advice from you had no influence on the IWB of the teachers in the networks of the three participating schools.

Overall, it can be concluded that the social network position related to advice seeking, sharing new ideas, being considered as an innovator or a traditionalist, of the teachers in the networks who participated in this study, cannot explain the differences that exist among the categories that were established using teachers IWB.

Conclusion and Discussion

This section of the paper will firstly summarize the overall conclusions of the study. Next, possible explanations for these findings will be explored. Following that, the scientific and practical implications of the paper will be explained. Finally, the limitations of the study, and recommendations for future research will be noted.

Conclusion

The focus of this study was to determine the extent to which a teacher's social network position explains the level of IWB that is exhibited by groups of teachers. Based on the study, it can be concluded that the social network position does not explain the different levels of IWB that teachers display. Teacher's exhibited different levels of IWB, allowing them to be assigned to one of five innovator categories that reflected how innovative they are. Social network analysis was conducted to determine whether the differences that exist among the categories could be explained by a teacher's position in the network. However, there was no evidence that social network

position influenced teacher's innovator categories, and therefore determining the extent to which social network position affects IWB, is limited.

Innovator categories

With regards to the innovator categories, it was expected that different groups would emerge similar to those as described by Rogers. The findings of the study confirmed that five innovator categories could be established using IWB, and that they could be loosely linked to Roger's categories. For example, the early adopters as identified by Rogers, were said to have been frequently asked for advice, while both the early adopters and early majority are known for having new ideas shared with them (Jacobsen, 1999; Rogers, 2003). Two of the innovator categories, defined in this study, indeed exhibited similar behaviours to those described. That said, not all of the innovator categories determined in this study were definitively comparable to the categories set out by Rogers. For example, the network results indicated that no true laggards existed among the teacher's in this study. These findings are in line with those of Ozcan, Gokcearslan and Solmaz (2016), Coklar and Ozbek (2017), and De Vocht and Laherto (2017), who also found no true laggards in their studies of teachers' individual innovativeness. This can be explained by the high expectations on teacher nowadays, to cope with the many challenges of rapid change in relation to education (Van der Heijden, Gelden, Beijaard & Popeijus, 2015), meaning that teachers can no longer afford to be laggards.

Another possible explanation for no laggards existing among teachers is offered by Erno (2015). He suggests that the nature of teaching means that unexpected events occur daily, causing teachers to become more accustomed to constant changes, and therefore they are a highly adaptable group of professionals. Ritter and Jensen (2010)

suggest that due to the demands to be adaptable, laggards are no longer attracted to the profession of teaching.

Predicting innovator categories

For the purpose of this study, four elements of social networks were used to try to explain the differences that exist between the five innovator categories that were determined by the IWB of teachers. More specifically, who teachers sought advice from, shared their new ideas with, whom they considered to be innovators and whom they considered traditional in their teaching methods, were investigated. The expected result was that one or more of these social network elements would impact which innovator category teachers were assigned to. However this was not the case, and in fact none of the four elements of social networks were found to have any influence on the teachers innovator category . These findings are contrary to previous research (Moolenaar, Daly & Sleegers, 2010) and can be explained by the context of the study. The research carried out by Moolenaar, Daly and Sleegers (2010), was done so in 51 elementary schools in The Netherlands. According to the Dutch Inspectorate (2017), few students with a migrant background are entering teacher training institutes, suggesting that the teaching staff across The Netherlands is relatively homogeneous. International schools on the contrary, have staff bodies that often represent a wide diversity of cultural and ethnic origins (Hayden & Thompson, 1995). Research carried out in schools (Frank, 1995, 1996; Heyl, 1996) suggests that the principle of homophily impacts teachers social networks. This means that teachers tend to share ideas and seek advice for example, with individuals who have a similar ethnic and social backgrounds. It is therefore more likely that social network position would impact teachers innovator categories in local schools, where there is a more homogeneous staff body, than in the international schools featured in this study, which are usually made up of a

multi-cultural staff body. Moreover, according to Umphress, Labianca, Brass, Kass and Scholten (2003), building professional relationships takes time. Moolenaar (2012) supports this view, stating that relationships that are given time to develop are usually stronger and more durable. Forming strong, durable relationships is particularly important with regards to innovation, since sharing new ideas and asking for advice for example, involves some level of risk, as it may change how people perceive you (Moussaid, Kammer, Analytis & Neth, 2013). Unlike local schools, international schools have a high turnover rate (Odland & Ruzicka, 2009), making it difficult to form such relationships with colleagues. High turnover rate is therefore another potential reason that social network analysis did not impact teachers innovator categories in the context of international schools.

Scientific and practical implications

It is widely acknowledged that the adoption and implementation of innovations is a complex process. Much empirical research has been undertaken in this field and a wide range of factors that influence the success and failure of innovations has been put forward. However, despite a number of scholars (Hopkins & Reynolds, 2001; Moolenaar, Sleegers, Karsten & Zijlstra, 2009b) having identified social network position as a key factor, research surrounding it is very limited. This paper is therefore scientifically relevant as it builds upon current empirical research. Not only does the research introduce a new context of international school settings, it also integrates a validated tool that measures IWB and successfully defines innovator categories that exist among actors. Identifying the innovator categories that exist not only provides opportunity to further investigate the role of social network position, but opens up the possibilities to investigate a wide range of factors that may potentially affect IWB, such as personality traits or trust to better understand the differences that exist between the

categories. This in turn leads to a better understanding of the diffusion process in itself as well as providing key insights into influencing factors.

It is important to recognise that school improvement is high on the agenda of schools worldwide (Hopkins, 2007), yet more often than not, attempts to innovate in educational settings fail. This study is practically relevant in that it provides a means to categorise teachers based on their IWB, which could potentially provide schools with important insights. For example it could act as an assessment to understand how teachers view each other in relation to innovations. Alternatively, decisions as to which actors should be involved at the first stages of innovations would be informed therefore likely to be more effective. For example, Yamashita (2006) states the importance of knowing who the teachers with most concerns are, as these need to be alleviated before an innovation can take effect. Tools to help laggards to come on board at an early stage would also be a possibility. Jundt, Shoss and Huang (2015) point out that while laggards used to be ignored, it is becoming more and more important to get them on board as many innovations work at the team level. More support for the early adopters to better advise their colleagues could also be provided.

Limitations and Future Research

While the study was innovative in trying to break new ground both in content and context, there are some limitations that need to be addressed. Firstly, the cross sectional design of the study means that caution must be taken when generalizing conclusions about the different innovator categories that exist, and the role that social network position plays in explaining the differences between categories.

Although the study has provided a useful insight into the IWB and social network position of international school teachers, future research would greatly benefit from a longitudinal approach. Since Roger's diffusion of innovation model, the theoretical

framework on which the research was based was plotted over time, it would be useful to also map the innovation categories found in this study, over time, in order to further make comparisons with Roger's categories, that are scientifically valuable.

A second limitation to consider is the low statistical power of the study, which was a result of time constraints. It is possible that one or more of the social network elements had an effect, but it was not detected due to the small sample size of the study (Type II error). Care must therefore be taken with regards to making pragmatic recommendations. Despite this possibility, the research remains useful in that it identifies the IWB levels of teachers in international schools and possible social network elements that may have had an impact on this. However, should the study be replicated in the future, care should be taken to ensure an adequate sample size is achieved.

A third limitation of the study was, that data was only gathered from teachers. While the study goes beyond using only self-reported data through the inclusion of social networking questions, the input of student perspectives could greatly benefit future studies. Although teachers play a highly prominent role in implementing innovations in schools (Sharma, 2001), student outcomes are often the measure of how effective an innovation has been (Owen, 2015; Guskey & Sparks, 1991). Hence, student perspectives on teacher's social networking and IWB could potentially prove invaluable, as well as strengthen the triangulation of the study, by building on the collection of data from multiple sources.

A final limitation to consider is that one of the three participating schools (School A), had a lower response rate (37%) than for network analysis (Moolenaar, 2012). School A differed from other primary schools that were removed from the study due to a low response rate, in that the teachers who responded made up the core of the teaching

staff (classroom teachers rather than specialist teachers). Although the participation of the specialist teachers may have expanded the study, the network that exists among the classroom teachers still provides valuable insight.

It is also important to note that Roger's model assumes that the gathered data follows has normal distribution. However, Peterson (1973) points out that, like the data gathered in this study, it is much more likely that deviation from the normal curve occurs. Since Rogers provides no empirical or analytical justification for categorizing normal data, investigation of an alternative approach that involves no underlying assumption of normally distributed data would be beneficial (Mahajan & Muller, 1990). However, other models are not without their shortcomings and the behavioural attributes that Rogers applies to his categories were highly relevant to this study.

Although some suggestions for future research were outlined in relation to the limitations of the study, it is important to note that external factors could potentially impact the IWB and/or social network position of teachers. For example, the location of the school may play a role. Continuation of the study with more than one school based in the same country would lead to better insight into whether location could be an influencing factor.

It could also be beneficial to undertake a comparative research were local schools are studied to identify whether social network position plays a role in such an environment and compared to the international schools that participated in this study. This could give insight into whether or not the principle of homophily indeed impacts teachers social networks.

As was revealed during the process of this study, it is also likely that no true laggards exist within this group of teachers. Should the research be replicated, it would be beneficial to use the four cluster solution rather than the five cluster solution

generated by Ward's hierarchical clustering analysis. This would generate different sociograms and could potentially reveal that one or more of the social elements; advice, new ideas, innovators and traditionalists does have an impact on teachers IWB.

This research paper has brought to light important information regarding innovations and social networks of teachers in international schools. Further investigation of these aspects should be carried out to further expand empirical evidence.

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