Chapter 8

Effect of innovativeness on teachers' use of ICT

One of the factors identified in the first phase of the study as influencing teachers' adoption of ICT for teaching and learning was their level of innovativeness. The mandatory introduction of a new innovation, investigated in the second phase of the study, provided the opportunity to focus one of the research questions on looking at teachers' levels of innovation as a factor affecting their use of ICT. This chapter deals with, firstly, the development of a method for classifying teachers wanting to use computers for pedagogical purposes into adopter categories, based on levels of innovativeness. Secondly, the classification of teachers who participated in the second phase of the study into adopter categories is reported. Finally, the research question dealing with the association of teachers' levels of innovativeness and their usage of ICT for teaching is answered.

8.1 DEVELOPING A METHOD FOR CLASSIFYING TEACHERS INTO ADOPTER CATEGORIES

In his theory of the diffusion of innovations Rogers (1962) classifies individuals into categories based on "*the degree to which individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of the system*" (Rogers, 2003, p. 12). Rogers thus focuses on the relative rate at which individuals take up an innovation. However, placing people into adopter categories based on rate of uptake of an innovation is of limited usefulness – it only tells you about how many people have taken up the innovation before others in that system and does not provide insight into the characteristics of the people in the different adopter groups. I could not use Rogers' criterion of 'rate of adoption' (as has been done by e.g. Sahin and Thompson, 2006 and Loogma et al., 2012) to classify the teachers at the case study school into adopter categories because the *DigiDays* innovation was a mandatory change implemented by all teachers at the school, so the teachers would all have had to adopt the innovation at the same time. Since I was interested in supporting teachers to make judicious use of ICT in ways which benefit learning, I wanted to know more about the characteristics of the teachers in the different adopter groups, not just how fast they adopted ICT in their classrooms. In Chapter 2 (see 'Level of innovativeness' on page 49), I pointed out that innovativeness is viewed in different ways by various researchers, e.g. van Braak (2001) refers to innovativeness as "*a positive attitude towards change*" (van Braak, 2001, p. 44). Thus 'rate of uptake of an innovation', as used by Rogers, may not be the only way to determine level of innovativeness. In the section on 'Level of innovativeness' in Chapter 2 I interpreted 'innovativeness' as a willingness to explore new ideas – whether this is displayed as an attitude or manifests as a behaviour – rather than relating innovativeness only to 'rate of adoption'. Since I could not use 'rate of adoption' I needed to find other features I could use to classify teachers into adopter categories.

Although he classifies individuals into adopter categories based on the rate of uptake of an innovation, Rogers (1962) also describes a number of general characteristics for his five adopter categories. These descriptors served as a starting point for my efforts to find other ways of identifying levels of

innovativeness. Table 39 lists the most important features Rogers uses to describe his adopter categories.

Table 39. Rogers' adopter categories and some of his descriptions (Rogers, 2003)

Adopter category	Features
Innovators	• the first to adopt • venturesome • eager to try out new ideas • not afraid to take risks
Early adopters	• adopt after innovators, not too far ahead of the rest • less maverick than Innovators • selective about new ideas • more respected than Innovators
Early majority	• adopt just before the majority of the individuals in the system • deliberate longer than Early Adopters • need more convincing to adopt an innovation than Early Adopters • follow rather than lead
Late majority	• adopt after the majority of the individuals in the system • cautious about new ideas • need social pressure to adopt an innovation • have to be convinced that it is useful
Laggards	• last group to adopt • focused on traditions • very reluctant to change • may need to be pressured to adopt an innovation

8.1.1 Developing a questionnaire to identify adopter categories

In Phase 1 of my study I classified four teachers into adopter categories based on interview data (see pages 124-126 in Chapter 4). With the larger sample of 29 teachers participating in the second phase of the study, the lengthy process of interviewing teachers was daunting, so I explored using a questionnaire to obtain the information I needed. Other researchers had used questionnaires based on Rogers' model of 'rate of adoption' in various *"studies on the use of ICT in different educational settings*" (Loogma et al., 2012, p. 810), but the questions were very limited, and focused only on rate of adoption. For example, Sahin and Thompson (2006) classified faculty members in their study into adopter categories based on their rate of integration of ICT into their teaching using a single question based on when faculty members started using technology for teaching. Loogma et al. (2012) classified the 273 teachers in their study into adopter categories using just two questions, both of which relate to rate of adoption (even though they refer to the first question as an 'attitude'):

> *One of these concerned the respondent's general attitudes towards the adoption of ICT tools ("When have you usually begun to use new ICT tools?"), while the other question was more concrete and concerned the actual application of e-learning in teaching ("When did you begin to use e- learning courses in teaching?").* (Loogma et al., 2012, p. 812)

I set about developing a questionnaire based on several features other than rate of adoption. I decided on a short, quick to administer and analyse, online questionnaire with multiple-choice questions to place teachers into one of five adopter categories named by Rogers. The multiple-choice format was used because this only required teachers to select the option which best applied to them, thus minimising the demands of my research on their time.

Defining suitable features and descriptors for grouping individuals into adopter categories

Rogers' general characteristics for his adopter categories (see Table 39) were used as a starting point for identifying features I could use in the questionnaire. Based on his descriptions I identified five features (see the rows in Table 40), each of which formed the basis for one questionnaire item, and then developed descriptors for each of the five adopter categories based on Rogers' descriptions (see Table 39).

Table 40. Adopter categories and descriptors for the questionnaire (based on Rogers, 2003)

Features	Adopter category				
	Innovators	**Early adopters**	**Early majority**	**Late majority**	**Laggards**
Time of adoption	first to adopt	adopt after innovators, not too far ahead of the rest	adopt just before the majority of the individuals in the system	adopt after the majority of the individuals in the system	last group to adopt
Reason for adopting at this time	venturesome – interested in trying out new ideas	adopt a new idea because they want to maintain a central position in the communications network of the system	Difficult to define descriptor	adopt because they feel socially pressured to do so	Are typically resistant to change and are thus reluctant to try something new
Attitude towards new ideas	not afraid to take risks or make mistakes in the process of adopting an innovation	tend towards less risky behaviour and more towards making astute decisions about new ideas	deliberate for some time before adopting an innovation	cautious approach to new ideas; most uncertainty must be removed before they adopt	wary of change; focused on following traditions rather than trying out new ideas
Degree of persuasion needed	none	little persuasion needed	Difficult to define descriptor	need more convincing than those who adopt earlier	high level of persuasion needed – may verge on coercion
Level of technical skill	are able to understand and apply complex technical knowledge	technically competent; would only need help with more difficult technical issues.	Difficult to define descriptor	not highly technically skilled; would require help with many technical issues	lack technical skills; would require help with most technical issues

However, I encountered a number of difficulties when trying to use Rogers' descriptors to develop the sets of characteristics which would help me identify the adopter category into which teachers fitted

- **Continuous versus discrete traits.** Although Rogers describes his categories as "*mutually exclusive*" (Rogers, 2003, p. 263), some of Rogers' traits (e.g. how inclined individuals are to try out something new or how venturesome individuals are) are continuous, making it difficult to describe where one adopter category ends and another starts. While it was simple to identify opposing features for categories at the extremes of the continuum for each trait, it was often difficult to find variations of the trait that could be used as suitable descriptors for the middle group, the *Early majority* category (see Table 40).
- **Some features were only tendencies.** Several of Rogers' traits are typical characteristics which may not apply to all individuals in a particular category. For example, Rogers describes *Early adopters* as 'more respected than *Innovators*' (see Table 39). Since it is unlikely that all

Early adopters are respected by their peers, typical traits like this one would not help me to place teachers in one of the five categories

- **The continuum was not always logical across the five categories**. Some of Rogers' traits are anomalous for certain groups, i.e. they did not follow a logical progression across the adopter categories. Again, the example of the *Early adopters* being 'more respected than *Innovators*' is applicable, as this trait does not represent a logical progression across the five categories.

Because I encountered difficulties using the descriptions provided by Rogers, I set about finding **distinguishing features** (rather than general typical descriptions) to place individuals into one of the five categories. I also needed to identify discrete descriptors (rather than continuous ones) which defined a feature as it applied to each particular category.

Although Table 40 contains five features, the feature based on teachers' rate of adoption could not be used in the questionnaire. As already explained, because the *DigiDays* innovation was a mandatory change implemented by all teachers at the school they would all have adopted the innovation at the same time. This left four usable features for the development of the questionnaire.

The process of identifying suitable traits from Rogers' descriptions and defining descriptors for the different categories was discussed a number of times with my supervisor, who was both familiar with Rogers' work and with the construction of research instruments. This resulted in many cycles of reworking and rewording until we were both satisfied with the information in the table. The next step was to design the questionnaire based on the remaining four features in Table 40.

Developing the questions and alternative answers

In my study, each of the remaining four features from Table 40 (excluding teachers' rate of adoption) became the focus of one multiple-choice question. In order to accommodate the five adopter categories it seemed logical that five options should be provided for each multiple-choice question, one descriptor for each category. The assumption underlying this structure was that teachers' responses across the four questions would allow them to be classified into one of the five adopter categories. Thus, for example, it was assumed that *Innovators* would select a particular set of options across the four questions, allowing for them to be classified into this category, and so on for the remaining adopter categories. A similar rationale has been used by other researchers to place teachers into adopter categories (e.g. Loogma et al., 2012).

Developing the alternative choices for the multiple-choice questions required long and hard thought about how someone in each adopter category would be likely to react in each case, and using these assumptions and predictions to design the multiple-choice alternatives for each adopter category, for each question. During the first phase of the study I had classified four participating teachers into Rogers' adopter categories (see Chapter 4, pages 124-126). When doing so one criterion emerged as an important indicator of a teacher's level of innovativeness: whether or not the teacher would take the time and effort required to actively seek out new software to include in their teaching. This factor was added to Rogers' descriptors, as part of one of the items for the questionnaire.

When wording the questions it became necessary to consider that some teachers might not have used technology for teaching before the mandated usage of ICT on *DigiDays* was introduced. These teachers might struggle to answer questions based on descriptors using actual behaviours relating to previous use of technology for instruction. To overcome this potential problem the questionnaire was worded so as to base it on a hypothetical scenario, and teachers were asked about their likely responses.

The options were randomised so that teachers would not be able to pick up any pattern across the four questions (one question per feature). Three of the four questions in the questionnaire had five options, one for each adopter category. However, one question had four options, because of the difficulty of finding distinguishing descriptors for the *Early adopter* and *Early majority* categories for the question "How are you likely to have become aware of the new application?" Both the *Early adopter* and *Early majority* categories would not have found the new application for themselves (which would have made them *Innovators*), but they would not have been likely to have waited until the school informed them about it (which would have made them either *Late adopters* or *Laggards*). Both the *Early adopter* and *Early majority* groups would have heard about the new application from someone else. It was therefore impossible to distinguish between these two groups and a single option was offered which combined these two groups. It was intended that other questions would separate individuals into the two *Early adopter* and *Early majority* groups.

The process of developing the questions and options was face-validated by my supervisor who checked the wording of the questions and options, and that the options linked teachers to an adopter category, leading to many iterations of the questionnaire. The final questionnaire may be found in Appendix K: *Questionnaire 3: Teachers' levels of innovativeness*.

Analysing the questionnaire data

Marshall and Rossman (1995, p. 111) describe data analysis as "*a messy, ambiguous, time-consuming, creative and fascinating process*". In analysing the data to classify the teachers two problems emerged which proved difficult to solve. I was encountering the messy nature of research, which Mellor (2001) says reflects the messy nature of reality. Two particular difficulties contributed to the problem of analysing the questionnaire data.

- **Teachers did not fit neatly into the designed categories**. The anticipated outcome – that particular responses for each question would be characteristic of teachers in a particular adopter category, resulting in four answers for each teacher which would place them in a particular adopter category – did not emerge. Not all teachers had answered as anticipated, i.e. they had not always selected the options designed to link them to a particular category. Only two of the 28 teachers (excluding the IT teacher) could be placed unambiguously in a definite category, based on all four of their responses to the questionnaire. This meant that either the validity of the questionnaire was dubious and challenged the choice of features for classifying the teachers, or there were problems with how respondents were answering (perhaps wanting to please me with answers they felt were appropriate), or both. None of the several pattern searches and permutations I tried helped to identify unambiguously the adopter category for most of the responding teachers. Based on the possibility that my questionnaire had validity problems, i.e. was not measuring what it had been designed to measure, I set up interviews

with seven teachers who had not yet been interviewed, to gather more data to identify where the problems lay, and which might be useful for improving the validity of the questionnaire.

- **Apparent inappropriateness of some features used.** The question on teachers' level of technical skill seemed to be the feature which caused the most difficulty with anomalies. Rogers had asserted that innovators have the ability to understand and apply complex technical knowledge, and my findings from the first phase of this study had suggested that computer innovators have high levels of technical skill, and that a lack of technical skill prevented teachers' from using computers. An example of a case in which 'level of technical skill' obfuscated the placement of the teacher is that of Teacher 17. This teacher, who clearly came up as an Innovator, based on the questionnaire, was not technically skilled, but was using very creative ICT methods in her teaching. This raised the question of whether the relationship between level of technical skill and innovativeness was a distinguishing characteristic, eventually leading to technical skills being discarded as a feature.

Bates (1967, as cited in Green, 1982, p. 217) describes research as "*the process of going up blind alleys to see if they are blind*". Although I had followed a number of blind alleys when analysing the questionnaire one of them yielded the idea of developing a key for identifying adopter groups.

While analysing the data, I had recorded the findings in a decision diagram (see Figure 73, on the facing page). Decision diagrams and trees are used to solve problems and as classification mechanisms (Cechinel, Sánchez-Alonso, & García-Barriocanal, 2011). Mingers (1989) offered the following description of how decision trees can be used to classify examples:

> *The best attribute is chosen, and the data are partitioned into subsets according to the values of that attribute. This process is recursively applied to each subset until all the examples are correctly classified. The result is a tree in which nodes represent attributes and branches represent possible attribute values or ranges of values.* (Mingers, 1989, p. 288)

As pointed out by Morse (1971) there are some aspects of decision-tree making that relate to "*the theory of keys"* (Morse, 1971, p. 275). My supervisor and I are both biologists, where keys are used for classification of living organisms. She pointed out the resemblance between my decision diagram and a biological key and wondered if there was merit in developing a key as a quick and easy tool to classify teachers into adopter categories.

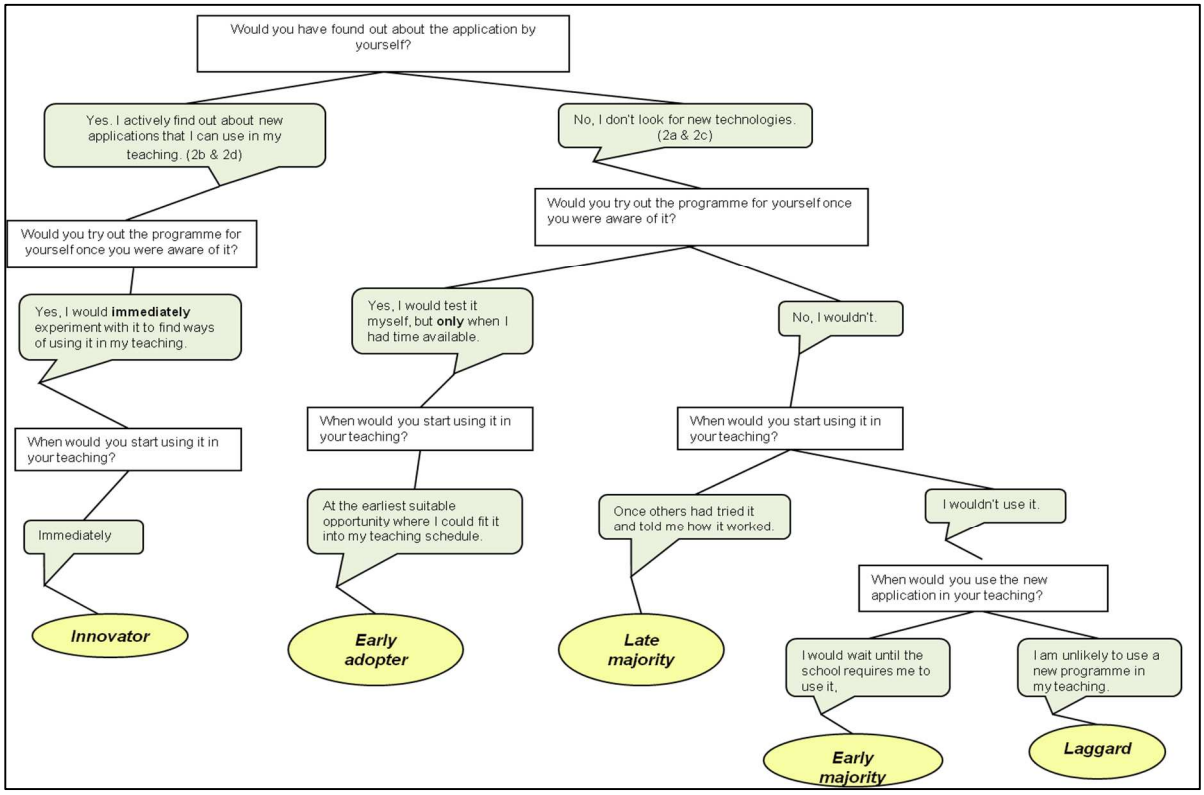

Figure 73. The decision diagram which led to the idea of developing a key

8.1.2 Developing a dichotomous key to classify teachers

Keys are used as tools in biology to identify specimens, or to classify them into particular groups (Morse, 1971; Newell, 1970; Walter & Winterton, 2007). Although there are different forms of keys including yoked, pictorial and circular keys (Tilling, 1984; Walter & Winterton, 2007), and tabular keys (Newell, 1970), dichotomous keys are regarded as the traditional format (Tilling, 1984). Dichotomous keys require users to choose between pairs of mutually exclusive descriptions until the specimen or object is identified. Walter and Winterton offer the following description of a dichotomous key:

> *In the pure dichotomous (also dichotomic) form, two sets of contrasting characters called leads (also legs or lugs) form each couplet; the choice of one lead takes a user to an end point (identification) or a pointer to the next couplet.* (Walter & Winterton, 2007, p. 196)

A well-constructed key can function as a "*simple but powerful logical tool that allows rapid and accurate identification*" (Walter & Winterton, 2007, p. 197). The process functions as an algorithm, so well-constructed keys are easy to use (Morse, 1971).

Despite my experience with using keys, as a student and teacher of biology, constructing the key proved to be a time-consuming and frustrating task. Figure 74 shows one of the early keys, which had to be discarded. The key shown in figure used more than one feature to divide groups. This key did not work because when one feature in the descriptor applied to a teacher and the other did not that teacher could not be classified using the key. Figure 38 shows another example of an early key. The lack of clear patterns in teachers' questionnaire responses had suggested there could be more than one way to end up in a category. In the version of the key shown in Figure 38 I attempted to make provision for more than one pathway for teachers to end up in an adopter category. This was one of

the ‘blind alleys’ that was pursued, as this key was not useful for conclusively placing teachers into adopter groups, possibly because it was not sufficiently parsimonious.

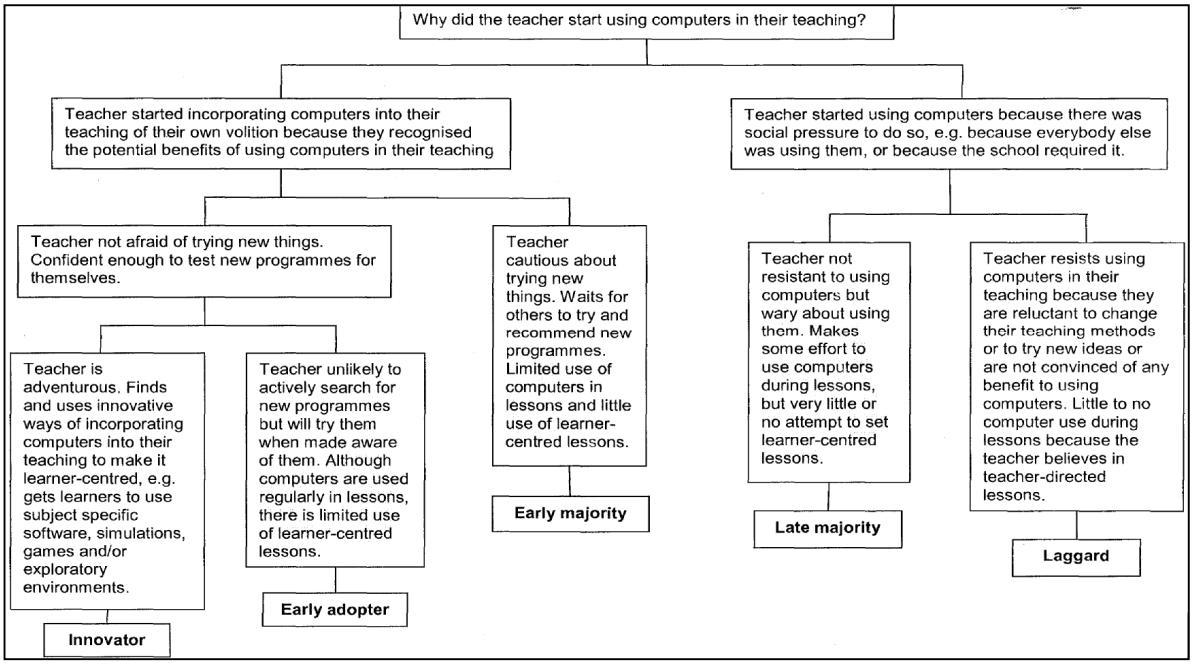

Figure 74. An early key which used more than one feature to divide groups

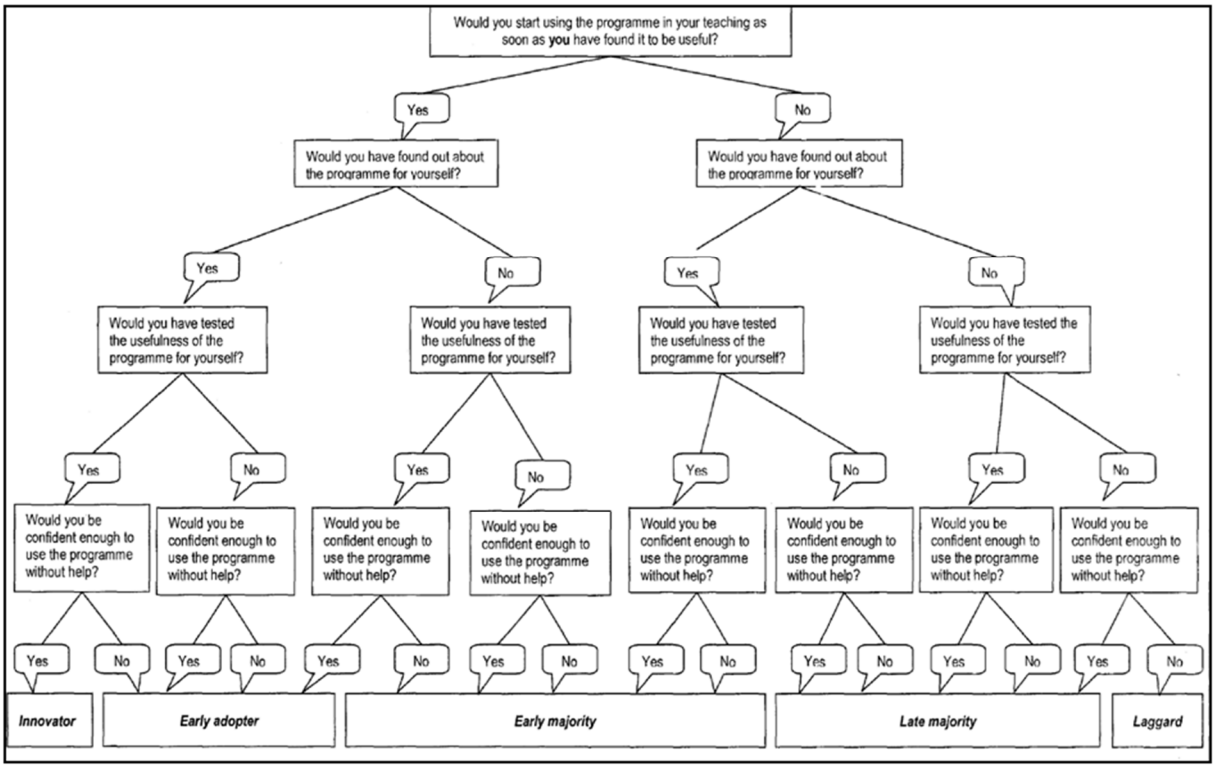

Figure 75. An early key which allowed for more than one pathway to an adopter group

After numerous unsuccessful attempts at producing a useful key, I consulted the biological literature on keys to see whether it gave advice on constructing keys. Some of the most useful information, which now appears self-evident, came from Walter and Winterton (2007), who emphasise the importance of avoiding *"overlapping, continuous characters, subtle differences or exceptions*" (Walter & Winterton, 2007, p. 199). I had already discovered these problems in my early attempts at developing the questionnaire. Other useful pieces of guidelines for constructing keys were as follows:

- Morse (1971) suggests that, when constructing a key, the initial group should be subdivided using the

  > *best possible character couplet, then consider each of these subgroups separately, dividing them similarly.* (Morse, 1971, p. 275)

- Walter and Winterton (2007) recommend the use of a single distinguishing feature per lead or couplet of options and wording feature descriptions clearly to avoid ambiguity.

These simple guidelines were used to rework the key, but I still had to decide whether to split off groups one at a time. Biologists recognise two forms of dichotomous keys: comb-shaped and fan-shaped (Walters & Winterton, 2007). Either categories are split off one at a time (comb-shaped key – see A in Figure 76) or the sample is progressively divided into smaller and smaller sub-groups until eventually the categories emerge (fan-shaped key – see B in Figure 76). Fan-shaped keys typically require fewer steps before all the objects have been grouped (Walter & Winterton, 2007).

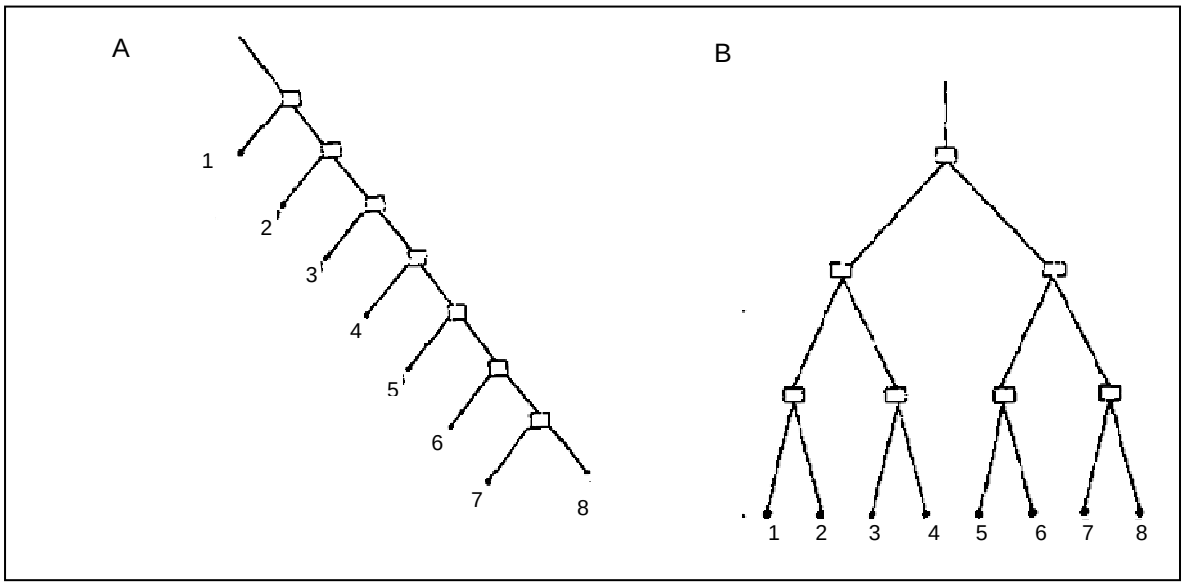

Figure 76. Comb-shaped (A) and fan-shaped keys (B)

The key is shown in diagrammatic form (see Figure 77 on the next page) and in verbal form (see Figure 78, also on the next page). The key (see Figure 77) is a combination of a comb-shaped key (the first group splits off) and a fan-shaped key, because this combination gave the best results when the key was later used to classify 27 teachers from the second phase of the study, as discussed in the next section. Although the idea of using a key to classify teachers into adopter categories emerged while analysing the questionnaire data, and was initially aimed at improving the validity of the

questionnaire as an instrument, the key eventually formed part of the method developed for classifying teachers into adopter categories.

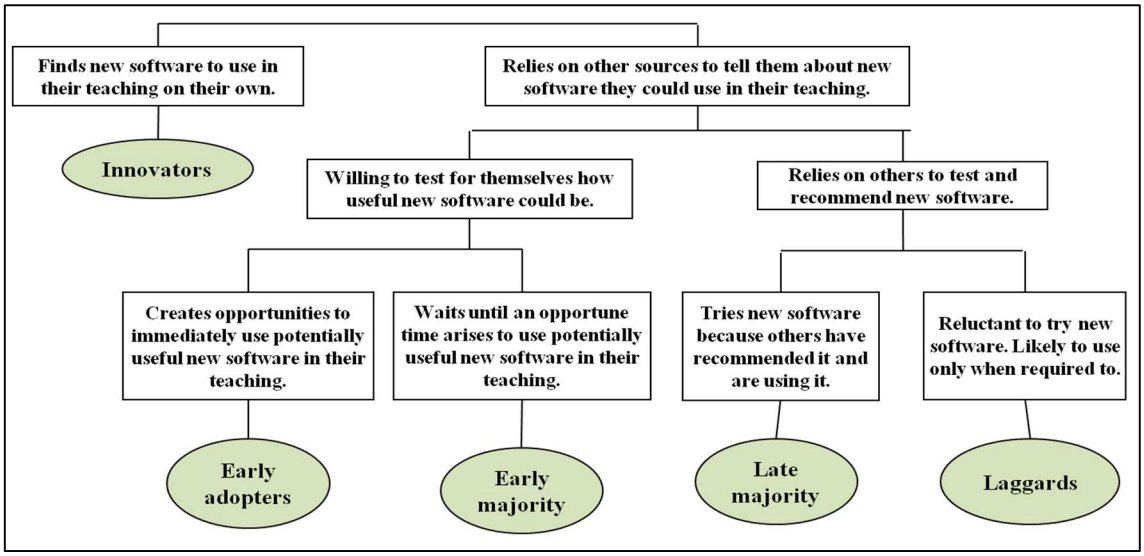

Figure 77. The diagrammatic form of the key

1a	Finds new software to use in their teaching on their own.	**Innovator**
1b	Relies on other sources to tell them about new software they could use.	Go to 2
2a	Willing to test for themselves how useful new software could be.	Go to 3
2b	Relies on others to test and recommend new software.	Go to 4
3a	Creates opportunities to immediately use potentially useful new software in their teaching.	**Early adopters**
3b	Waits until an opportune time arises to use potentially useful new software in their teaching.	**Early majority**
4a	Tries new software because others have recommended it and are using it.	**Late majority**
4b	Reluctant to try new software. Likely to use only when required to.	**Laggards**

Figure 78. The verbal form of the key

8.1.3 Reworking the questionnaire

The problems with the questionnaire not identifying teachers unambiguously led me to review the teacher interview transcripts to obtain more ideas to improve the validity of the instrument. The idea was that once the key had been developed the questionnaire would be changed to fix the previous problems noted, and that the questionnaire and key would be used in conjunction to place teachers in adopter categories. Content analysis (see Chapter 3, pages 80-81) of the interviews conducted with the 29 teachers provided additional insights into how and why teachers were either using or not using computers for instruction. As pointed out by Hardman (2005, p. 102) "*interviews can be useful tools for*

unpacking motives and experiences". Analysing the interview transcripts confirmed the idea of basing the questionnaire on a hypothetical scenario involving teachers' willingness to look for and try out new software to use in their teaching, rather than basing it on teachers' actual behaviours, since some teachers might not have been using computers for teaching before the introduction of *DigiDays.*

The final step in the development of the method for classifying teachers into adopter categories involved changing the original questionnaire to match the final key. This involved

- eliminating the question on teachers' level of technical skills. In many of the inconclusive cases this question had obfuscated the decision to place teachers into particular categories.
- reorganising the sequence of the questions in line with the key.
- reducing the number of response options to narrow down the choices teachers could make. It was hoped that a smaller number of options would better emphasise the distinguishing feature being focused on in that question.
- rewording the response options to ensure they focused on a single, distinguishing feature.
- changing the wording of a problematic option from one item in the original questionnaire (see Appendix K) which appeared to have obfuscated the results for a number of teachers. The question asks teachers "How would you find out whether the programme could be useful in your teaching?" On closer examination one particular option for this question seemed to have been selected by a number of teachers, possibly because the wording might have appealed to their sense of professionalism. The option reads "I WOULD NOT TRY TO FIND OUT WHETHER IT COULD BE USEFUL as I know what works well in my subject". Teachers appear to have selected this option because of the phrase "as I know what works well in my subject". This wording was not used in the final questionnaire.

The final version of the questionnaire is shown in Figure 79, on the next page.

8.1.4 Concluding remarks about developing the method for classifying teachers into adopter categories

The questionnaire and key together form a diagnostic tool which educational institutions could use to classify teachers into adopter categories. The method is intended to be used as follows. Teachers would answer the questionnaire, while trainers responsible for technology training would use the key to place the teachers into adopter categories. Since different adopter categories display different characteristics and needs, classifying teachers would allow trainers to tailor professional development for specific groups, when trying to promote the use of ICT for meaningful learning.

A recurrent theme when developing the method for classifying teachers into adopter categories was the need to find suitable distinguishing features for different groups. It was difficult to derive distinguishing features from the generalised descriptions which Rogers uses to describe people in his categories. The generalised descriptions do not work in practice to categorise people. This was one of the most important lessons learned when developing this method. A second lesson was the importance of succinctly wording the descriptors for the different categories, to avoid ambiguity.

A limitation of this part of the study is that it the revised questionnaire has not been tested. Since a questionnaire based on teachers' levels of innovativeness had already administered to the teachers at the case study school, there did not appear to be much merit in using the revised questionnaire with the same sample of teachers.

Consider the following scenario. A new computer-based application that could be useful in the teaching of your subject has been released onto the market. You have just become aware of this application. Please select the option which would most accurately match your response were you to find yourself in this scenario.

1. How are you likely to have become aware of the new programme?
   a. I probably FOUND OUT ABOUT IT MYSELF. I am always looking for new programmes to use in my teaching.
   b. I've probably become aware of the new one from FRIENDS OR COLLEAGUES WHO HAVE BEEN USING IT.
   c. I probably heard about it because it is A SCHOOL REQUIREMENT TO USE IT.

2. How willing would you be to test, for yourself, how useful the programme could be in your teaching?
   a. I would TEST IT FOR MYSELF.
   b. I would wait until SOMEBODY ELSE HAS TESTED it and recommended it, before I tried it.

If you answered 2a please answer question 3. If you answered 2b please answer question 4.

3. Having tested the programme and decided that it could be worth using, how soon would you use it in your teaching?
   a. I would CREATE AN OPPORTUNITY TO TRY IT OUT IMMEDIATELY with my class.
   b. I would WAIT UNTIL AN OPPORTUNE TIME AROSE to try it out.

4. Someone recommends the programme to you. How soon are you likely to start using it in your teaching?
   a. I would start using it IMMEDIATELY.
   b. I would WAIT UNTIL THE SCHOOL REQUIRES ME TO USE IT.
   c. I am NOT LIKELY to use a new computer programme in my teaching.

Figure 79. The final version of the questionnaire for placing teachers into adopter categories

8.2 EFFECT OF LEVEL OF INNOVATIVENESS ON TEACHERS' USE OF ICT, AFTER THE INNOVATION

This section answers the following research question, restated below for convenience:

> 3.3 To what extent, and in what ways, did their level of innovativeness affect teachers' use of technology?

Before I could answer the research question, it was necessary to classify the teachers at the case study school into adopter categories to be able to comment on the extent to which, and the ways in which their level of innovativeness affected their use of ICT. Table 41 shows the results of classifying 27 of the 29 teachers into adopter categories based on the key developed in the previous section, and using data from two questionnaires and the interviews. The Information Technology and Computer Applications Technology teachers were excluded from this count because their extensive use of computers for teaching made it difficult to separate criteria for innovativeness from required teaching use. The teachers are arranged in descending order of innovativeness in Table 39, and evidence is provided for the decision to place a teacher in a particular group, based on the criteria in the key.

Table 41. Adopter categories of 27 teachers

Innovators (will find new software for themselves, and use it)	
17	Looked for new software to use in her teaching, e.g. she had found the subject-specific software to use in the Afrikaans language lab she set up for learners. She had also set up a *Twitter* site for learners.
25	Looked for new software to use in her teaching, e.g. she had started a *Facebook* group for learners on which she posted quizzes, videos etc. She found out about how to set up multiple-choice quizzes on *Moodle* and designed quizzes which her department then used. She also described creating games for learners to use in class.
33	This teacher actively sought out resources, including new software, to use. He described himself as "*continually looking*" for interactive websites and new software to use in his teaching. *... new applications in the classroom which I want to try and which I've set up some material which I'm going to be using …*
39	Actively sought out new software to use, e.g. she had found the free PHeT science software at her old school, and had introduced this to other members of her department when she started at the case study school.
28	Looked for new software to use for teaching, e.g. he said that he downloaded video tutorials to learn how to use new programmes in his teaching.
Early adopters (will immediately create opportunities to test and use new software, once told about it)	
40	This teacher indicated that he would find an opportunity to immediately try out new software when he was made aware of it by others, e.g. he had tried out the PHeT software once he was made aware of it.
3	In the first phase of the study this teacher had been classified in the *Early adopter* category (see pages 125-126 in Chapter 4). He said he would find and opportunity to try out new software once he found heard about it from others.
Early majority (will test and use software, once told about it, but only when opportune)	
27	This teacher was open to trying new things when she heard about them, but only when there an opportunity arose to use it which she felt would be beneficial to learning.
37	This teacher was open to trying new things when she found out about them, but only when an opportunity arose which she felt would be beneficial to learning. *… everything that we do, we … we are trying to enhance the mathematical content of our syllabus.*
32	This teacher had been using computers before the innovation and was willing to try out new things, when he was made aware of them: *I like new things and … I'm more confident to my abilities* [sic] *when it comes to that.* He indicated that he would try out new software when he had time to fit into his teaching schedule, suggesting that he belongs in this category rather than the Early adopter category.
16	This teacher was not interested in looking for new software and relied on others to find out about new software to use in her teaching, but would try something out if recommended and when she had time.

Late majority (will try new programmes if recommended and others are using them)	
38	This teacher had made limited use of computers before the innovation, but had been encouraged by seeing how others in the Mathematics Department were using computers to want to use computers more in her teaching.
24	This teacher was open to trying new ways of integrating recommended technology into recommended by other teachers, and saw others using it successfully. For example, she was keen to learn how to set up multiple-choice quizzes on *Moodle* once she had heard about Teacher 25 doing it.
34	Before the innovation this teacher had made little use of computers despite having the resources available. However, when required to use ICT for teaching she had responded enthusiastically and was willing to try out new things on computer. In her case study (see page 257 in Chapter 7) she made reference to having learned something or learning that is taking place as she used ICT more frequently.
36	This teacher explained how she depended on other teachers to recommend software to use in her teaching: *… I, out of my own accord … don't necessarily always just try new programmes and I often rely on other people to sort of first show me how to use the programme. Once they've shown me how basic it is and I'm confident enough to go around and play in it and try and figure it out, you know? But I often rely on somebody else first to show me*. Because she would only try out new software once she had seen others using it, this teacher belongs in the Late majority category.
30	This teacher depended on others to make her aware about resources, but would use them if she found them useful: *… I use sites that people tell me about. I look into it first and see if it's relevant ... whatever website … I don't really use a lot of … say, things I don't know about … and then communications other history teachers make, they'll send a link for something and then I'll look into it.* She indicated that she would only try out new software once she had seen others using it.
22	This teacher was willing to use to try new things, but had taken a long time to adjust to the idea of using computers for teaching, suggesting that she needed to see general changes in the school before she started using ICT more. When interviewed, in the second year of the innovation, she said: *… starting to become more experimental, but with basic stuff ... and from this year it started to get a little bit more … experimental in terms of what I actually upload.*
18	This teacher was using computers in response to the introduction of the innovation at the school: *… it now forced me to go on the computer and see what everything was … how it all works … and making me … it's actually made me more … computer literate. Because it was nice for me even to like do the … my worksheets. I redid all my worksheets for the whole Grade 9 syllabus …so that I could now upload the stuff in colour.* The implication that she had been 'forced' suggests that she might not have started using computers of her own volition. However, her comment suggests that she has responded positively to being required to use computers, which means that she cannot be classified as a *Laggard*.
7	This teacher described having started using computers because the school required it: *Well, I had to do … well, by ... by force I suppose, in the beginning because … at the end of the day, the whole school was electronically ... so that's how I was introduced to it and then … ja, obviously just one thing led to another and you stay on the thing.* The implication that she had been 'forced' suggests that this teacher might not have started using computers had the school not required her to do so. However, because she has not resisted using computers she cannot be classified as a *Laggard*.
35	This teacher's willingness to use computers suggests that she should be placed in this category. She expressed intentions of using computers in her teaching based on what she heard from others, even though she seemed to never quite have got around to trying out the new things she had seen: *... the end result of what I can see other people do at* [IEB] *conference and that sort of thing, I think certainly does encourage me to think "Well, I … I really have to make a plan." ... but then you sort of fall into the trap and you think, "Okay. I'll do it next week.*
14	This teacher had been using computers before the innovation, but displayed a lack of inclination to spend the time and effort trying out new resources, even when others found the resources and informed him about them: *… ja, I think probably if I … knew … sites ... subject- specific … if I could get that then I'd probably use it a lot more … and that's probably down to me doing some research and finding … sites that … that can help. I know the Afrikaans teacher sent us something the other day … to look at which I haven't had time to look at yet, which I will still look at this week ...* Because he was not resisting the use of technology, and his reluctance to try new things could be attributed to a lack of motivation rather than an unwillingness to use computers, he has been placed in the *Late majority* category.

29	This teacher was using computers only to comply with the school's requirement to use ICT for teaching. She said was perfectly happy with what she was currently doing and would only use *Moodle* when required to. Despite not using computers very effectively (see case study 12 on page 275, Chapter 7), she can be placed in this category because she displayed some willingness to learn, saying her computer skills were continually improving.
Laggards (reluctant to try new software, even when recommended, and may need 'coercion')	
15	Outside of the required usage this teacher made little use of computers except when required to. Most of her computer usage centred around usage on *DigiDays* and in the Afrikaans language lab, where she would be *using computers only because she had to.* Her computer usage can thus be regarded as involving coercion rather than free choice.
2	This teacher was using computers only when required to. Her lack of innovativeness is evident in the comment below. *Don't ask me to try out anything new. That's what I use my husband for. But I can do what I need to do. I'm not adventurous.*
21	This teacher was afraid of using computers and doing "*irreparable damage*". She said that technology "*stresses me".* Although she said she was not a "*Luddite*", she displayed a negative view towards using technology for teaching, and said that she would rather resort to traditional methods of teaching: *I'd far rather just say "Bloody well, sit down and ... sit down and do it in class".*
19	This teacher was only using computers when required to, on *DigiDays*. She sticks to what she feels comfortable with, saying she prefers to "*stay safe*" and does not want to get "*too adventurous*". She was thus only using computers when she had no choice but to do so.
23	This teacher had never used a computer in the classroom and was only using computers when required to. For example, she only prepared computer-based work for learners when required to for *DigiDays*. Even then she said another teacher had loaded the task onto *Moodle* for her.

Figure 80 shows the percentages of the 27 teachers in the different adopter groups, based on the classification in Table 41.

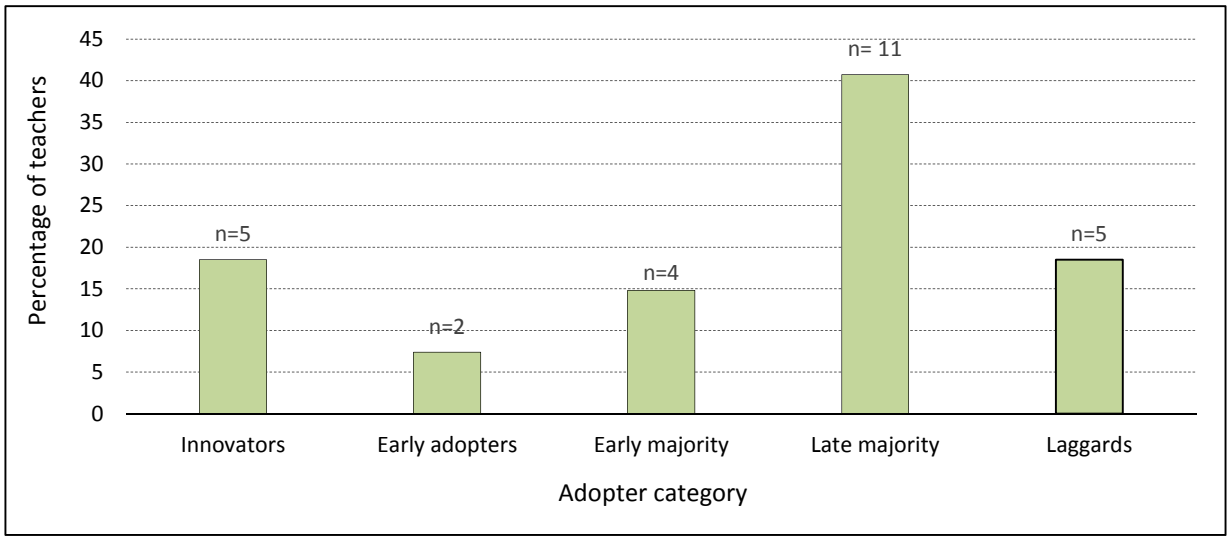

Figure 80. Percentages of teachers in adopter categories

Looking at the extent to which, and in what ways, the teachers' level of innovativeness seemed to be associated with their use of technology for teaching and learning revealed the following:

- **Innovators**. Five of the 27 teachers (19%) were classified as *Innovators.* All had found sotware on their own, and had done this even before the implementation of *DigiDays*, and their innovativness continued after the innovation. The most innovative teachers (Teacher 17 and Teacher 25) were using technology in a variety of different ways and were using it often. For example, Teacher 17 said she used computers for teaching every day, after the innovation (see

case study 4 on page 259 in Chapter 7). These two teachers were also willing to experiment with using social media for teaching, outside of the classroom. As Teacher 17 explained (see case study 4 on page 259 in Chapter 7), she had only discontinued using her *Twitter* account for teaching Afrikaans due to a lack of interest from learners. These teachers appeared to be willing to taking risks (which Rogers identified as a characteristic of innovators – see Table 39) without being sure of whether the new method of using technology for teaching that they were trying out would benefit learning. Although the remaining three innovators found new software on their own, they were less adventurous in how they integrated technology in their teaching. Teacher 33 was also experimenting with using *Twitter* for teaching, but during lessons rather than ouside the classroom. He was also only doing so because, together with Teachers 17 and 25, he been asked by the school to investigate the use of *Twitter* for teaching in the classroom, suggesting that although he was prepared to try new things, he was not as prepared to take risks as Teachers 17 and 25. Thus risk-taking seems to be a general rather than a distinguishing characteristic of innovators, and cannot be used to classify people into this adopter category. Teachers 28 and 39 directed their innovativeness less towards trying out new things for the sake of doing so, but rather in ways that enhanced their teaching, suggesting a more pragmatic (yet innovative) approach to using technology.

- **Early adopters.** The two teachers (7%) who were placed in this group did not find their own software and relied on others to tell them about new ICT applications they could use in their teaching. However, once they became aware of new applications they created an opportunity to test and use it for themselves. Both teachers had been using computers for teaching long before the innovation was introduced at the school, and both had a clear idea of how to use technology in ways which enhanced their teaching and benefited learning. For both teachers their computer usage did not increase significantly after the innovation, because, unlike some of the teachers classified as *Innovators*, these two teachers were not interested in experimenting with new applications. Rather they were focused on the benefits offered by utilising technology for learning. Both of the *Early adopters* tended to use ICT for a particular purpose in their science teaching, e.g. to demonstrate a process or to enhance learners' understanding of an abstract concept. The computer usage was thus dictated by their pedagogical needs.
- **Early majority.** The four teachers (15%) who were placed in this group relied on others to tell them about new ICT applications they could use in their teaching, and once they became aware of new applications they were willing to test it for themselves (they had already had the recommendation), but only when an appropriate time arose for trying out the new application. This suggests a more cautious and pragmatic approach than the two *Early adopters*. All four of these teachers had been using ICT before the innovation was introduced, but with varying frequencies. Teachers 27 and 32 had been using computers frequently for teaching, before the inovation, in ways which benefited learning in their subject, but usually to do with using computers in lessons for visual displays (e.g. *PowerPoint* presentations and videos). These teachers knew what worked well in their respective subjects and would only use new software if they were convinced that such usage would benefit learning. Teacher 37 had not been using computers as much as these other two teachers, possibly because of the nature of her subject (Mathematics) did not lend itself to using technology as much as the subjects taught by Teachers 27 and 32 (Geography and Life Orientation). Teacher 16 had been encouraged to make more use of computers after the innovation, but her computer usage was less discerning

than that of other three teachers in this group, tending towards unfocused, almost 'accidental' usage.

- **Late majority.** The largest group consisted of 11 teachers (41%) who were not interested in finding new applications to use in their teaching, but who would try out new software once others had tried and recommended it, and when they had seen others using it. These teachers had either used computers only occasionally before the innovation, or had not been using computers at all. However, all of them displayed a willingness to make more use of technology outside of the mandated usage required by the school, although they differed in the degree of persuasion they needed to use ICT. Some teachers in this group (e.g. Teachers 38 and 24, required little persuasion to use computers for teaching, outside of the manadated usage, once they had seen what others were using computers for. Others (Teachers 36, 34 and 30) were using technology more in lessons, but were hampered by a lack of ICT knowledge and skills. Some of these teachers' were prepared to learn as they went along. For example, Teacher 34 was setting computer-based tasks for her learners for *DigiDays* involving things she did not know how to do, e.g. drawing graphs in *Excel*, which could improve her ICT skills and possibly her level of confidence. Some teachers in this group (Teachers 18 and 7) expressed the view that they had been coerced into using computers, but had then found some benefit to using computers, and continued doing so.
- **Laggards.** The five teachers (19%) placed in this group were only using computers because it had been mandated for *DigiDays* and did not extend the use of ICT into their other teaching. For example, Teacher 23, while she prepared all her lesson notes on computer, had never used a computer for teaching in her lessons and had avoided loading the *DigiDay* tasks she set by asking other members of her department to load them. Their reluctance to use ICT outside of required usage meant that the five *Laggards* might have been missing out on opportunities to use technology in ways that could benefit learning in their subject. However, the case studies for two of these three teachers [Teachers 19 and 23 – see case studies 6 (page 263) and 13 (page 277) in Chapter 7] suggested that a lack of ICT competence could be a reason why they were not using computers more in their teaching.

Classifying the 27 teachers into adopter categories emphasises that while mandated change could force teachers to use computers, it did not necessarily result in teachers' uptake of ICT outside of the mandated usage. Rather, teachers' use of ICT outside the required usage was affected by their belief in the merit of making the required change, their level of innovativeness, and whether they possess the necessary knowledge and skills to make the required change a meaningful one, in terms of improving learning. Identifying the adopter category a teacher falls into could be useful for tailoring professional development based on teachers' needs, to better ensure the diffusion of an ICT innovation beyond the mandated change.

8.3 CONCLUDING REMARKS

This chapter looked at the effect of innovativeness on teachers' use of computers in teaching, based on the research question relating to the extent of, and the ways in which, teachers' level of innovativeness influenced their use of technology for teaching, especially after the introduction of *DigiDays* when they gained experience using ICT, albeit mandated change. The chapter first

described the development of a brief, online multiple-choice questionnaire for grouping teachers based on four criteria derived from general features described by Roger's for his five adopter groups. Problems encountered when analysing the data collected using the questionnaire led to the development of a dichotomous key to improve the validity of the questionnaire. The key subsequently became part of a method which can be used by educational institutions to efficiently group teachers in order to provide differentiated support based on teacher's needs. Finally, the research question dealing with the effect of teachers' level of innovativeness on their use of ICT was discussed, and it was concluded that innovativeness may be useful as an indicator of teachers' willingness to adopt ICT for teaching, and allow educational institutions to provide differentiated support for teachers wanting to integrate ICT, in ways that promote the meaningful use of ICT.