# BLOGGING TO SUPPORT INQUIRY-BASED LEARNING AND REFLECTION IN TEACHER STUDENTS´ SCIENCE EDUCATION

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## Abstract

*This study aims to clarify primary school teacher students' experiences about the use of blogs in the context of a science course which includes collaborative inquiry-based approaches and a field trip. Teacher students were asked to design and conduct a small inquiry and report the phases of the process in a blog and then write their ideas about inquiry-based teaching and learning in it. The inquiry process was loosely scaffolded by linking the blogs together. The students were also asked to fill in a questionnaire of technological pedagogical content knowledge (TPACK), in order to acquire insight into their views on the scaffolding needed for their own inquiry process, as well as the role of scaffolding in the inquiry method in primary school. The findings showed that after discussing them with each other, teacher students were able to formulate personally meaningful problems for their investigation. Teacher students investigated multidisciplinary elements and learned about different phases of the inquiry and the blogs enabled them to follow the process of others. Teacher students' information retrieval and processing skills developed through out the inquiry and aided them in other teacher education courses, also giving them a firm foundation and confidence in accessing and applying information as life-long learners.*
**Key words**: *inquiry learning, ICT, biology, teacher students, scaffolds*.

## Inquiry Learning and ICT

Previous research has frequently highlighted that an inquiry-based approach and field work are not only important but essential in teaching and learning about ecology at primary and secondary school level, as well as at university level (e.g. Chin & Chia, 2006; Ergazaki & Zogza, 2008; Finn, Maxwell & Calver, 2002; Sander, Jelemenska & Kattman, 2006). After careful comparison of inquiry learning models Bell, Urhahne, Schanze and Ploetzer (2010) discovered that collaborative inquiry learning had been described consisting of the main elements similar to those of the inquiry process. Almost each of them starts from the "orienting and asking questions"-process, from which students ideally find the driving question to be investigated by scientific means; this is followed by the hypothesis generation process in which an observable relation between variables can be formulated. In the planning process, validation of the hypothesis is explicated by the selection of appropriate measurement instruments or methods. The investigation process consists of empirical actions to collect information or data e.g. making experiments, measurements, and organizing the data. In the analysis and interpretation phase, the data should be used for making arguments for or against the hypothesis. In the case of science learning, there should be a process of model creation or refinement based on the

theoretical considerations combined with the results of the inquiry process. In the conclusions and evaluation process, all the students' previous accomplishments should be evaluated against other experiments and theory on the field in questions, in order to find out how the results fit within the theory or models. Communication is described as a whole process lasting part of the inquiry and leading to reflection on one's own work, at the same time collaborating with other participants of the inquiry work. Finally, the "prediction" process connects the knowledge already gained and the results of the inquiry process, into broader possibilities of application to the theory which might lead back to the starting point, asking new questions and orienting to a new inquiry circle (Bell, Urhahne, Schanze, & Ploetzner, 2010).

The description above of collaborative inquiry learning, is not linear with even the simple cyclic sequence of the main processes, instead the authors point out that the sub processes are interconnected and students have to make several attendance into the same main process during the inquiry. The studies, that formed the basis of the above mentioned categorization, focused on computerized environments, to support collaborative inquiry learning and tailored scaffolding in the difficulties which students experience during different phases of the inquiry process. Bell et al (2010) shows that there is a great variety of effective computerized inquiry environments that can support students' inquiry learning by using a variety of scaffolding methods. However, it is still clear that the teacher has a major role in the actual enactment of the inquiry learning process in the classroom, not to mention the integration of the inquiry learning process into the requirements of the curriculum (Fishman, Marx, Best, & Tal, 2003).

Since a dedicated computerised collaborative inquiry learning environment is not always available it is necessary that teachers have the skills to plan and carry out the inquiry process with their pupils. Teacher education should be able to support teacher students´ development of skills, knowledge and habits required in conducting inquiry learning processes. Unfortunately neither the teachers' nor the teacher students' readiness (Fishman, Marx, Best, & Tal, 2003; Williams, Linn, Ammon, & Gearhart, 2004; Kim & Tan, 2011; Windschitl, 2003; Windschitl, 2004) can be taken for granted. In a series of studies, Windschitl (2003,2004) has shown that teacher students' conceptions of inquiry learning is too simplified, linear, unproblematic, and too loosely connected to theory or modelling (Windschitl, Thompson, & Braaten, 2008). Windchitl (2004) also points out that the actual willingness of the teacher or students to carry out inquiry based teaching, seems to be explained more by their previous experiences of participation into demanding scientific research or into very demanding inquiry teaching and learning. It will take years of practice to be skilled in the use of methods of inquiry, relevant content knowledge and reasoning, within this domain.

Recently there has been heavy emphasis toward using social software as tools for collaborative learning practices. Social software like blogs, wiki-environments, Facebook etc. have been described as software which support users' interaction and collaboration (Boyd, 2003). According to Alexander (2006), social software sets users into more active roles; users create and publish material, comment on each other's work, create and participate, acting simultaneously both as readers and writers (Maged et al., 2007; Sinclair, 2007). These characteristics of social software align well with the features of inquiry learning by Bell et al (2010) described in the previous paragraph. Social software provides numerous tools for supporting students' active interaction and the building of new knowledge during the inquiry process. Based on these characteristics of social software, blogs were also used in this study for supporting teacher students' inquiry and reflection on teaching.

### *Technological Pedagogical Content Knowledge*

Williams, Linn, Ammon, & Gearhart (2004, p 190) characterise the demands: "Inquiry teaching is challenging for many elementary science teachers, because it requires them to

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integrate and utilize deep understanding of science content, pedagogy, and technology." This kind of teacher knowledge and thinking can be called Pedagogical Content Knowledge (PCK) and it contains knowledge about techniques and strategies for fostering meaningful learning. According to Shulman (1986, 1987) PCK consists of:

- Content knowledge: knowledge that includes central theories and concepts, also the nature of the knowledge and means of inquiry of the field.
- Pedagogical knowledge: understanding of learning processes and the ability to control and guide the learning situation.

Recently the effect of introducing technology into this PCK framework has been further developed in addition to developing the concept of technological pedagogical content knowledge (TPCK) (Koehler & Mishra, 2005). TPCK offers a framework for investigating the skills and knowledge involved in integrating information and communication technology (ICT) into teaching (Koehler & Mishra, 2009). The additional element (due to Technology) to PCK framework is:

- Technological pedagogical knowledge: understanding of the benefits and disadvantages of various technologies in their relation to different pedagogical aims and practices.

This kind of knowledge is needed in order to be able to choose suitable tools for different tasks and for different students. Technological pedagogical knowledge is also needed for understanding the effect of employing different technologies in teaching and learning (Koehler & Mishra, 2005, 2009).

Teachers are considered to develop their knowledge and understanding through critical reflection. Usually these reflection processes are triggered by an unexpected or puzzling event which cannot be handled with daily routines (Schön, 1987). It has also been noticed that the reflection process is in connection with the community, their values, shared knowledge and goals (Shulman & Shulman, 2004). In the case of teacher students, their own school experiences as pupils affect the way they think about teaching. This complex process is hard to describe and analyse, but in the case of using blogs for reflective dialogue, Granberg (2010) has developed matrix presenting critical dimensions of reflection, based on Kreber and Cranton's (2000) circular model of scholarship (Table 1).

**Table 1. Matrix presenting reflection types. It is based on Granberg's (2010) modified model from Kreber and Cranton's circular model of scholarship, with considerations of personal learning experiences.**

| Teaching | Instructional knowledge | Pedagogical knowledge | Curricular knowledge |
|---|---|---|---|
| Content reflection (What) | What design, material and methods were used and what would I use? | What do I know about how I learn and children learn? | What do I know about the goals and rationale of my studying and future teaching? |
| Process reflection (How) | How do I know if the design experienced and my design, material and methods will be effective? | How will I know if teaching was successful in facilitating my learning and how will I be successful in facilitating children's learning? | How were the goals and rationale assumed to have been fulfilled and how would I fulfil the goals and rationale in my teaching? |
| Premise reflection (Why) | Why does it matter what methods, materials or course design were used and what would I use? | Why does it matter if I find out how I was supposed to learn and why does it matter if I consider how children learn? | Why do goals and rationale matter? (to my learning and my future teaching) |

In this study teacher students' learning through inquiries and field work supported by blogs is studied. The research questions are:

1) What aspects of inquiry learning and the use of blogs are reflected upon in teacher students' blogs?
2) How do teacher students reflect upon their inquiry learning and the use of blogs in their own blogs?
3) In the view of teacher students, why should inquiry learning and blogs be used in science learning?

## Methodology of Research

The primary school teacher students studied a curricular unit of winter biology. Their understanding of the unit was monitored focusing on: biological and chemical phenomena and processes, the teaching of these phenomena by inquiry method, field work and the use of blogs.

### *The Context and Participants of the Study*

The research was conducted on a voluntary course of science education. The course "Winter in economy of nature and man" has been offered for the past several years. Considering collaborative inquiry-based learning approaches and field work, it aims to encourage primary school teacher students to gain a deeper understanding of the scientific evidence of the winter ecology of plants and animals as well as human-environmental interactions. The course was conducted at the beginning of February and March in the year 2011. The course consisted of lectures (6 hours) and working in groups (20 hours of field work in forest). The aim of the lectures was to introduce the theory of winter ecology concerning Finnish plants and animals. At the beginning of the course there were 16 teacher students but only 12 teacher students engaged in field work and passed the course.

First, the teacher students discussed their own perceptions about winter and shared them with their peers. Second, each teacher student read the National core curriculum (grades 1-6). They wrote down three or four specific, practical topics and research questions that aroused their interest when reading the National core curriculum on the context of winter. The teacher students were informed that the topic and research questions should address or be resolved during the field work and inquiry-based learning. The instruction encouraged teacher students to think about the connections and possible applications of winter ecology and to consider why a particular method and experiment was being used in science education.

At the beginning of the second lesson the teacher and teacher students discussed the National core curriculum. The idea of the National core curriculum is to promote pupils' studying processes towards a global and holistic understanding of natural and environmental issues. The teacher students were guided to think about winter from varying viewpoints. The goal of the Finnish National core curriculum is for biology instruction to be founded on inquiry-based learning, developing pupils' thinking in the natural sciences as well as giving pupils the ability to observe and investigate nature, life and its phenomena. The National core curriculum highlights that school science learning should be approached from a holistic view point, strengthening the multidimensional aspects of learning. The curriculum also guides teachers to consider the learning task as an integrated subject which closely relates to the pupils' own lives. In the core curriculum, winter is included in several core contents of biology and chemistry:
1) *Organisms and living environments* (the basic features of living and lifeless nature, various living environments and the adaptation of organisms to them, nature through the seasons, the most common species of plants and animals in the pupils' immediate environment).
2) *Substances around us* (properties and changes in the state of water)

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3*) The human and health* (caring for one's own health)
4) *The home region and one's immediate environment, the world as an environment for human habitation* (the immediate environment, seasonal change, home and provincial regions; natural conditions, landscapes, constructed environment, and human activity). (see National Board of Education 2004.)

The teacher students freely chose their own group and then divided up into three smaller groups (3-4) in which to define their own inquiry project which was based on the Finnish National core curriculum (2004). Research questions, made hypotheses and decided tools were developed for use in addressing and each of the three groups made a blog and named it. Members of each group began by writing what they thought about inquiry based learning and teaching, concerning winter ecology. Before the teacher students embarked on their inquiry project, the teacher gave them a short briefing on the inquiry-based model.

The next phase of teaching (20 hours) took place in an outdoor environment, during which the teacher students performed their own inquiry project work: e.g. gathered and analyzed data, constructed arguments and communicated their findings. All teacher students were required to produce a blog during the course, at the end of which each group gave a 30 minute oral-presentation. Finally the teacher and teacher students discussed and reflected on the results of the inquiry process, blogs and the role of field work and inquiry when based on learning and teaching.

*Data Collection and Analysis*

Research data consists of the students' written work in their blogs, concerning inquiry-based learning, the use of blogs and the role of both of them in primary school science education. A group of four students worked with one blog which was related to their topic and altogether there were three different project blogs. Before inquiry work, the teacher students were asked to write about their conception of inquiry learning with a few sentences and twelve blog postings were written in these three blogs. During the project, teacher students reported the advancement of their work in their group blogs. In addition, they were asked to write reflectively about the role of inquiry learning in their own learning, in their future teaching, use of the blog in their own inquiry learning project and about future primary school (inquiry) teaching expectations; about two to three pages of postings (text) per blog. Further, the teacher students answered an e-questionnaire concerning technological pedagogical knowledge which was sketched out by the questionnaire based on the Archambault and Barnett (2010) TPACK survey (see APPENDIX). The writings were uploaded to the HyperResearch-software and analysed qualitatively. The questionnaire was analysed quantitatively using only descriptive statistics due to few responses.

## Results of Research

Before inquiry work, the writings concerning inquiry-based learning were only very short, the key message being that inquiry learning is active working and learning by observing or learning by doing (Table 2). Only some of the main processes of inquiry learning were mentioned: conducting experiments (4 mentions), working with a research question (3 mentions) and some kind of analysis (4 mentions). Less was written about setting a hypothesis (one mention), working with theory (2 mentions) or reporting the results (2 mentions). Some of the processes Bell, Urhahne, Schanze, and Ploetzner, (2010) mention were totally missing, namely: clear definition of data collection, modelling and making predictions, meaning that the processes that combine the inquiry into wider conceptual and theoretical framework were almost totally missing from the preconceptions about inquiry learning.

**Table 2. Inquiry learning, teacher students' definitions in the pre-inquiry blog notes.**

| | Making observations | Learning by doing | Making analysis | Setting a hypothesis | Conducting of experiments | Working with research question | Reporting | Working with theory |
|---|---|---|---|---|---|---|---|---|
| Number of utterances in the blogs | 6 | 3 | 4 | 1 | 4 | 3 | 2 | 2 |

Blog postings during the inquiry learning project. The teacher students' reports of the inquiry started with blog posts describing an "orienting and asking questions"- process type of blog post, defining loosely the general aim of their inquiry projects. The three inquiry project topics were: differences in the pollution of snow in wilderness and town, snow and differences in plants overwintering, and human clothing differences in different circumstances. Each of which is included in Finnish core curriculum of primary school. This was followed by descriptions of the hypothesis, descriptions of a theory driven model and method development for data collection, analysis and hypothesis verification. The analysis and results were documented and a conclusion was written.

After the teacher students' own inquiry project, the reflective writings, revealed that the general impression about inquiry learning was more focused. The written texts clearly brought out the role of the defined research problem and theoretical understanding:

> "... in inquiry learning, pupils set their own research problem and figure out how it could be solved. Inquiry learning requires, among other things, that pupils have some kind of background knowledge on the issue to be learned: different working methods/research methods as well as sufficient time. If there is not enough time to think about the research problem and the methods to be used the work can fail. From the teacher's point on view, inquiry learning also requires familiarity with the issue and the ability to instruct several small groups."

This quote from a teacher students' writing, represents one of the best examples of the change in his/her conception of inquiry learning. The first line is similar to the conception before the inquiry project, but the last three sentences are new and clearly represent how this teacher student came to realize how demanding and complex inquiry learning is to enact in reality.

In order to find out a more focused view of the reflection of technological pedagogical content knowledge, the categories and guiding questions presented in Table 1 were used in categorizing the blog writings. The most common topic apparent in teacher students' reflection, was about premise (why) instructional approach (knowledge about inquiry learning and blogging, 22 mentions, lower line in Table 3). Secondly common topic was reflection of instructional content (17 mentions), what advantage or limitations this kind of instructional approach had and could have in own teaching. Third, big class was reflections of cross disciplinary integration of biology, ICT (blogging) and inquiry learning (14 mentions). Fourth category, premise reflection why (9 mentions) important learning experience was achieved and could be achieved in one's own teaching. Fifth category was reflections on curricular premises of ICT integration and inquiry learning (8 mentions). The process reflection (how) get altogether 12 mentions of which 7 were about instructional issues. There was less reflection on issues of pedagogical knowledge (4 mentions) and least (2 mentions) about how arrive at the goals and rationale.

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**Table 3. Categorizing of teacher students' written reflections in their blog texts.**

| Teaching | Instructional knowledge | Pedagogical knowledge | Curricular Knowledge |
|---|---|---|---|
| **Content reflection (*What*) (35 mentions or utterances)** | (17 mentions)<br>"Keeping a blog brings variation into teaching and documentation is quite easy, it can even be done by the pupils themselves"<br>"absolute advantage of blogging is to be able to follow each other's work. This property could have been used more, commenting, discussing, and asking questions about the other's work"<br>"Inquiry learning is certainly a motivating and interesting way to learn for primary school pupils. Pupils may influence to their inquiry from the topic and they may carry out the inquiry and report the results. During the inquiry they learn in practice how to use different equipment, registration of results and reporting." | (4 mentions)<br>"For this matter inquiry learning has its place. Its advantages are group work and knowledge sharing. They teach social skills, group work and interaction skills" | (14 mentions)<br>"In the beginning, this idea (blogging and inquiry) did not seem to be good because ICT seems to be included in every lesson"<br>"Blogging is a good idea for reporting, because simultaneously pupils could also learn media literacy and ICT skills" |
| **Process reflection (*How*) (12 mentions or utterances)** | (7 mentions)<br>"From the viewpoint of primary school, this kind of working requires a little bit more planning, but I believe it functions well. For example, keeping blogs has already been tried out in many schools and..." | (3 mentions)<br>"Issues will arise that are unfamiliar and...This kind of topic could be handled collaboratively and..."<br>"one must admit that in the inquiry project the findings remained somewhat superficial from the general view of the plants during the winter. Perhaps with more scaffolding and one's own contribution, we would have gone deeper." | (2 mentions)<br>"one has to admit that at the beginning I was sceptical: once again just an attempt to integrate information and communication technology into teaching, in this case with a blog." |
| **Premise reflection (*Why*)**<br><br>**(39 mentions or utterances)** | (22 mentions)<br>"Keeping a blog was a new and pleasant experience. The whole group's work is an organized representation in which everyone can participate according to their schedule. A blog also allows the interaction between groups."<br><br>"Keeping the blog was gradually fun and rewarding. I wondered how simple it was to get such a nice blog just with pictures and texts"<br>" | (9 mentions)<br>"Gaining concrete answers to a self posed research question, gives you the feeling of success and self-confidence as a scientific investigator"<br>"Considering one's future profession as a teacher, your own experiences of inquiry learning help you to understand the child in the same situation. What kind of problems and possibilities does this working method offer?" | (8 mentions)<br>"From the students' perspective, I can say that making the blog and studying it was in itself a meaningful inquiry"<br>"..inquiry learning works perfectly as a learning method, if the research question is meaningful and students really learn something with it ..." |

Students' technological pedagogical knowledge was sketched out with results of the TPACK survey. Unfortunately only 7 out of 12 teacher students filled in the questionnaire, so the results of the survey are only suggestive. The frequencies are shown in Table 4 and Table 5 in the appendix. On the nine items concerning pedagogical knowledge such as the ability to plan, sequence and scaffold, the teacher students' answers seemed to be somewhat confident (Table 4 appendix). On the eight items concerning technological pedagogical knowledge (Table 5 appendix) roughly half of the respondents were somewhat unconfident and other half more confident. They also reported to be somewhat confident in their ability to scaffold pupils in inquiry learning process working (last item Table 5 appendix).

## Discussion

The findings showed that teacher students were able to subsequently formulate personally meaningful problems for inquiry in accordance with curricular demands. However, teacher students well noticed the need for care and sufficient time in developing the research questions and suitable methods for the study. The complex and ill-structured multidisciplinary (interdisciplinary) inquiry problems they chose to work with, led teacher students to investigate several other disciplinary elements and concepts outside the typical school biology or chemistry syllabus. These problems required teacher students to also ponder on how they could find out what they wanted to know, and leading them to varied information gathering methods and different modes of inquiry (field studies, surveys) beyond the pre-inquiry learning project assumptions. This might imply the gradually developing, more accurate conception of inquiry learning and teaching as well as related professional knowledge and the teacher's skills that previous research refers to (Fishman, Marx, Best, & Tal, 2003; Williams, Linn, Ammon, & Gearhart, 2004; Kim & Tan, 2011; Windschitl, 2003; Windschitl, 2004). These features above seems to support the usage of blogs as to fulfil the need of flexibility of the inquiry learning environment as Bell et al (2010) poses as challenge. The teacher students used the social software in an active role; users did create and publish material, acted simultaneously both as readers and writers as Maged et al. (2007) and Sinclair ( 2007) suggest, but however they did not comment on other groups work.

The teacher students could critically reflect on the instructional approach of using blogs to support the process of inquiry learning, focusing on the content issues (what) and also figuring out premises (why) blogging supports the group working. They did not, however, reflect so much on what its effect was and how this effect could be achieved in future teaching. They also saw the curricular value of integrating ICT learning, biology fieldwork and inquiry, the learning of social skills and premises, (why) they are important but once again, not on how (process) it happens. There is a lot of similarity on ways of the reflection found in Granbeg's (2010) study, concerning the use of blogs in reflection. Namely, similarly in this study too, reflection on processes of how instructional, pedagogical or curricular aims are to be achieved were less frequently mentioned in the teacher students' writings.

The results of the questionnaire does however raise serious doubts about their actual confidence in applying online teaching (e.g. blogs) in their own future teaching. On the other hand in the reflective writings (Table 3) there were quite a lot mentions of instructional benefits of blogging, and similar development of technological pedagogical content knowledge can be seen as in Koehler´s and Mishra's (2005) study. One of the important challenges in the teaching and learning of biology, is the development of primary teacher students' abilities to use ICT in the context of biology education, for example in field work. This approach serves as a motivating experience but not enough to offer full confidence in one's own abilities.

## Conclusions

The combination of blogging, inquiry learning and field work was, in general, seen as a good combination. The teacher students clearly stated many good arguments for this kind of approach, as can be seen in Table 3 on the premises for instructional, pedagogical and curricular aims. For this reason one can assume that when a blogging and inquiry learning project are combined together, this encourages teacher students to reflect on their conceptions of teaching, the nature of scientific knowledge and the teaching and learning methods. These factors may increase motivation to adopt a demanding way of teaching with the inquiry learning method. Blogging seems to have supported the group communication well during the inquiry work, both within in the groups and to some extent between the groups, despite the fact that the teacher students still noticed that they did not comment on the other groups´ work online, in the blogs.

The teacher students´ development of variety of skills in inquiry work and using ICT effectively throughout these investigations, will not only aid them in their own teacher studies. It will also give them a firm foundation and confidence in accessing and applying their experience and knowledge gained as life-long learners in their work as future inquiry learning enacting teachers.

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## Appendix

**Table 4. Frequences of TPACK items concerning general pedagogical knowledge.**

| How confident?<br>1= not at all confident<br>6= extremely confident | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | Count | Count | Count | Count | Count | Count |
| My ability to plan a meaningful sequence of concepts taught within my class | | | | 1 | 6 | |
| My ability to easily produce lesson plans with an appreciation for the topic | | | | 2 | 5 | |
| My ability to determine a particular strategy best suited to teach a specific concept | | | 3 | 2 | 2 | |
| My ability to decide on the scope of concepts taught within in my class | | | 3 | 2 | 2 | |
| My ability to use a variety of teaching strategies to relate various concepts to students | | | 2 | 4 | 1 | |
| My ability to adjust teaching methodology based on student performance/feedback | | | | 3 | 3 | 1 |
| My ability to distinguish between students´ correct and incorrect attempts at problem solving | | 1 | 1 | 2 | 1 | 2 |
| My ability to anticipate probable student misconceptions within a particular topic | | | 3 | 3 | 1 | |
| My ability to create materials that are in accord with specific curricular standards | | | 1 | 3 | 3 | |

**Table 5. Frequences of TPACK items concerning technological pedagogical knowledge.**

| How confident?<br>1= not at all confident<br>6= extremely confident | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | Count | Count | Count | Count | Count | Count |
| My ability to moderate online interactivity among students (e.g. bloging) | | 2 | 1 | 3 | | 1 |
| My ability to implement different methods of teaching online | 1 | 2 | 1 | 2 | 1 | |
| My ability to use various courseware programs to deliver instruction (e.g., Blackboard, Moodle) | | 3 | 1 | 2 | 1 | |
| My ability to create an online environment which allows students to build new knowledge and skills | 2 | 2 | 1 | 2 | | |
| My ability to use technological representations (i.e. Multimedia, visual demonstrations, etc.) to demonstrate specific concepts in my content area) | | 1 | 2 | 2 | 2 | |
| My ability to use online student assessment to modify instruction | | 3 | 2 | 1 | 1 | |
| My ability to apply technology in accordance with specific curricular standards | | 1 | 1 | 3 | 2 | |
| My ability to meet the overall demands of online teaching | | 3 | | 3 | 1 | |
| My ability to scaffold pupils in inquiry learning process work | | | 2 | 3 | 2 | |

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