Evaluating a Living Model of Knowledge

Paul Parboteeah, Thomas Jackson and Gillian Ragsdell
Loughborough University, UK
p.parboteeah@lboro.ac.uk
t.w.jackson@lboro.ac.uk
g.ragsdell@lboro.ac.uk

Abstract: The definition of knowledge has always been a contentious issue in knowledge management. Effective knowledge management requires a definition of knowledge that is consistent, useful and true. Whilst most definitions today fulfil the first two criteria, none accurately address all three, including the true, biological nature of knowledge. This is where autopoiesis can help. Autopoiesis was developed to try to answer the question of what makes something living, using a scientific methodology. It proposes living things are discrete, self-producing entities and constantly cognising entities. Autopoiesis has long inspired definitions of knowledge, with ideas such as: knowledge cannot be transferred, or knowledge can only be created by the potential 'knower'. Using the theory of autopoiesis, it is possible to create a biologically grounded model of knowledge, representing the latest thinking in neuroscience. However, before this new, biologically grounded model of knowledge can be integrated into new or existing knowledge management theories, it needs to be tested, else it falls into the trap of being conceptual, and remaining that way. This paper starts with the autopoietic, and therefore biologically, grounded model of knowledge, and develops the new evaluation framework necessary to test the model. The evaluation methodology developed in this research started from the field of programme evaluation and was adapted to meet the needs of the knowledge management discipline. This paper subsequently presents the initial findings from the evaluation process and takes the first steps to identifying how knowledge management can improve with its newly found scientific grounding.

Keywords: autopoiesis, epistemology, evaluation, knowledge management, systems theory

1. Introduction

The 21st century is a knowledge economy (Drucker, 2001) and this has given rise to a new type of organisation: the knowledge intensive organisation. With knowledge a core strategic resource in these organisations, a new approach was needed that could help to effectively manage this new resource. Knowledge management (KM) was developed as the answer, and aimed to help employees effectively create, share and exploit knowledge to enhance the organisation's knowledge (Jashapara, 2004). Whilst this can be taken as an introductory position, there are a number of complicating factors resulting from different academic paradigms, such as strategic management, business process re-engineering, philosophy, information management and economics.

For a subject with at least ten underlying disciplines (Jashapara, 2004), the fundamental issues such as defining knowledge or the role of information technology (IT) in KM (Metaxiotis et al., 2005) can never be resolved. The different disciplines will always keep their perspective, which is fine in academia but, given the underlying structure of knowledge never changes, 'real world' organisations need to work from a consistent, and correct understanding of knowledge.

What is needed is a way to give KM a new foundation (Wong and Aspinwall, 2005) that is capable of encompassing all the underlying disciplines and perspectives, while at the same time not becoming just another perspective on KM. The use of systems theory has been suggested (Johanessen et al., 1999; Scholl et al., 2004), arguing it has the potential to combine the different perspectives that underlie KM. The notion that systems theory could be applied to KM is clearly very attractive, and in line with integrating KM to business processes, systems theory also has the potential to develop an organisation wide model of existence (Johanessen et al., 1999). As identified by Scholl et al. (1999) autopoiesis is a systems theory that could be applied to KM for the new foundation necessary.

Numerous authors have begun applying autopoiesis to KM (Maula, 2000; Hall, 2005; Limone and Bastias, 2006), and it does appear that there are commonalities between the numerous KM theories and autopoiesis. However, these studies have been very focused and narrow in scope, essentially going against the non-reductionist approach demanded by systems theory. A new need can be identified, whereby autopoiesis is applied to KM but at the same time recognising the inherent systems nature of autopoiesis.

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With this in mind, this paper aims to create an autopoietically-based model of knowledge and to develop a sufficient testing instrument.

2. Autopoiesis and living systems

Autopoiesis is a systems thinking theory of viewing living systems such that it can define 'beyond the diversity of all living organisms, a common denominator that allows for the discrimination of the living from the non-living' (Luisi, 2003). An autopoietic entity is defined as

> *'a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realization as such a network.' (Maturana and Varela, 1980)*

This definition highlights the importance of the network of processes (or relationship between the components) as the key notion in autopoiesis. It is the relationship between components (or organisation) that allows the machine to be living, not the actual components (the structure). It would then make sense to infer that autopoiesis is the act of maintaining constant a living system's organisation.

There are four consequences of an entity being autopoietic: autonomy, individuality, organizational closure and self-specification of boundaries (Maturana and Varela, 1980). Autonomy is the ability of an entity to specify its own laws and the behaviour it exhibits (Maturana and Varela, 1998). Maintaining their organization as autopoietic, living entities are also actively maintaining their identity (Maturana and Varela, 1980). Organizational closure is an essential feature of autopoietic entities, if they are going to remain living; if they did not maintain their autopoietic organization, they would disintegrate, and die. However, just because a system is organizationally closed, does not mean it cannot receive physical inputs (Mingers, 1995). An autopoietic entity is also able to specify its own boundaries. In the case of a cell, the internal dynamics produce the necessary components for the boundary, while at the same time; the boundary contains the processes of self-production (Maturana and Varela, 1998). Autopoiesis also provides numerous insights into knowledge (Limone and Bastias, 2006; Luisi, 2003; Maturana and Varela, 1980; Maturana and Varela, 1998; Mingers, 1995), and these are:

- 1. Without a question, or apparent lack of knowledge, no new knowledge will be admitted.
- 2. Knowledge gives certainty to acts.
- 3. Objective knowledge constitutes a description of that which is known i.e. there is no such knowledge.
- 4. There is only personal knowledge.
- 5. Informing is the process of converting data into knowledge

These five insights can be combined to create a new, autopoietic definition of knowledge: 'We admit knowledge whenever we observe effective action/behaviour in a given context (realm/domain), which we define by a question, either explicit or implicit.' It is not necessary to define the actual nature of knowledge, since it is necessarily embodied in the knower. The first insight states that a question is the starting point for the generation of knowledge. Without a question, the potential knower is not aware they lack knowledge on a certain topic, and therefore will not attempt to create any new knowledge. The second insight confirms the notion that knowledge is linked to action, and that any action is necessarily based on knowledge of the actor. The third insight attempts to objectify the problem with classifying knowledge as either tacit or explicit. It proposes that objective knowledge is not really knowledge, since it is merely a description of what the knower has knowledge of. The final insight articulates that knowledge can only exist when it is embodied in the knower, and that knowledge can never be stored independently of the knower. The notion of personal knowledge also implies that knowledge cannot be transferred to another knower, with no loss of meaning. The notion that informing is the process used to convert data into knowledge recognises the autopoietic position that only data and knowledge exist. Everything that exists in the 'real world' is data, and everything that is embodied within a person is knowledge. The data/information/knowledge hierarchy that is so popular is, in fact, a misrepresentation of the process, and attempts to make information an entity, as opposed to a process.

3. Creating the living model of knowledge

A suitable methodology was needed to create a new model of knowledge. Research methodologies typically fall into two categories: positivism and interpretivism. Positivists believe that all knowledge arises from observing phenomena in a real and objective world (Cornford and Smithson, 1996). Interpretivism, on the other hand, seeks to 'understand reality through the realm of individual consciousness and subjectivity' (Jashapara, 2004). Such an approach recognises that researchers affect the object they are researching, simply by researching it. However, neither a purely positivist or interpretivist approach is suitable for applying autopoiesis to knowledge management. However, an integration of ideas from both perspectives would be ideal, and this possible using matching. Matching is a new methodology developed by von Krogh et al. (1996) and is used for the integration of two or more theories. Often described as unifying languages and relationships, matching is a two-step process: theoretical discourse and inscription. Theoretical discourse is the frequent dialogue about the theories, from which a new language emerges and through which the theories unite. Following on from which is inscription, which can be defined as 'the process of making and presenting knowledge from the first stage, such that it can inform other theory building attempts' (von Krogh et al., 1996).

The matching process used to develop the model of knowledge in this paper took place over the course of several meetings between a PhD student and the supervisory team. All potential terms to be used in the model were discussed and definitions of words were explored to resolve any conflicts, for instance, whether the term 'observation' was purely related to sight, or all senses. Ideas pertaining to the data/information/knowledge hierarchy were discussed, along with whether information is a pseudo step that really represents the process of informing. Applications of the model were also explored to ensure terminology being used was not inherently restrictive. The second stage of the process involved the creation of the model of knowledge. After the initial model was created, it was subject to two reviews prior to being finalised.

4. The living model of knowledge

Having explored all aspects of autopoietic insights into knowledge, the final model can be presented (Figure 1). It shows how distinctions allow observations to take place and how those observations can lead to knowledge. It also shows that admitting knowledge depends on a lack of knowledge existing (in the form of a question) and also that knowledge leads to effective action. The model concludes that this action then leads to an opportunity for more observation to occur, provided that a question also exists such that more knowledge can be gained.

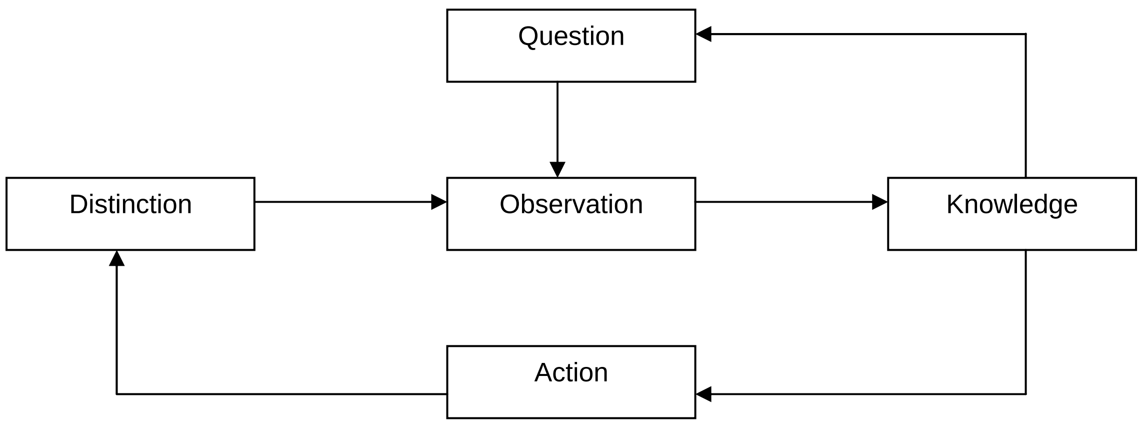

Figure 1: The living model of knowledge

4.1 Definition of terms

- Action – Physical (or mental) task carried out (possibly by yourself)
- Distinction – Must be able to tell apart the object under study (physical or conceptual) from its surroundings
- Observation – The object/action is detected by you
- Question – Identified from a lack of knowledge and requires further observation
- Knowledge – Black box, it is impossible to know the format/structure of human knowledge

4.2 Explanation of relationships

Distinctions and Observations

Living systems observe by making distinctions (Maturana and Varela, 1998) where observations are not necessarily related to sight, and as such, this should be the starting point for any model of knowledge. The argument for this is that any time we refer to anything, either explicitly or implicitly, a criterion of distinction is being made. This criterion indicates the object under observation and any properties relevant to the object. In other words, living systems must be able to tell apart an object it can observe from its 'ambient' environment. Subsequently, any object in the environment is observed, or perceived by an act of distinction. This is not an option process, 'we are necessarily and permanently immersed in it' (Maturana and Varela, 1998). For instance, consider a single swan in the middle of a large lake, with no other plants or animals around. It is only possible to see the swan because it can be distinguished from its ambient environment: the water and the sky. At nighttime, with no light, artificial or otherwise, the situation is different. With no light, it is no longer possible to see the swan since it cannot be distinguished from its environment. So, it is possible to see a direct link between observation and making a distinction: it is not possible to observe without making a distinction.

Observation and Knowledge

We admit knowledge whenever we observe effective action' (Maturana and Varela, 1998) is one of the cornerstones of an autopoietic view on knowledge. This direct link identifies the main 'handle' for working with knowledge as observation. It is important to note that the action can originate from either the knower or anything in the environment. Immediately, one problem arises: this view assumes that observing ineffective, or wrong, action does not lead to knowledge gain. However, considering the autopoietic perspective that 'failure' and 'ineffective action' are external concepts that presuppose a shared, common reality, it becomes apparent that the action is only viewed as ineffective by the observer. From the viewpoint of the actor, all action is effective action because it is always based on knowledge.

Knowledge and Action

As previously identified, there is a link between observing effective action and admitting knowledge; this means knowledge should lead to effective action, also indicating a direct relationship. This finding also correlates with previous work, which finds knowledge and action linked in a mutual relationship (Drucker, 1988; Orlikowski, 2002). Numerous examples of this link appear to exist, generally from 'training' perspectives. For instance, anybody old enough can pick up a paintbrush and paint a wall, however the quality will vary. If those people are trained how to paint a wall, they will inevitably increase their knowledge about painting, enabling them to be more effective in carrying out the painting.

Questions and Knowledge

Without a question, or apparent lack of knowledge, no new knowledge will be acquired (Maturana and Varela, 1980). This fundamental statement implies the presence of an internal, cognitive process that assesses current knowledge and determines whether there are any gaps, or inaccuracies that need addressing. The creation of a question, also addresses the issue that it seemed unsatisfactory to say people gain knowledge by just observing, based on literature surrounding single and double loop learning (Argyris and Schön, 1996).

Action and Distinctions

Any action a person takes as a result of their knowledge will result in an opportunity for observation (the opportunity also exists when observing action taken by others). However, as proved earlier, observation only occurs through making distinctions, therefore a link will exist between 'Action' and 'Distinctions'. However, a special case exists where a person observes the effect of their own action. In this instance, the model effectively becomes self-checking, because once the person takes action, they are able to assess if the desired outcome is achieved, and whether there is any room for improvement. This is essentially the role of reflection.

5. Creating the testing instrument

Ideally, the model would be tested to ensure all the elements of the model existed, along with determining the strength of the relationships between them. However, as previous research on epistemology has taught, testing models of knowledge is extremely difficult and fraught with pitfalls and no win situations. Different methods for testing this model could include placing it inside a larger model, which essentially acts as a testing rig. Alternatively, interviews could be used to test people in different scenarios, during which different aspects of the model would be tested. However, both methods of testing introduce numerous assumptions and other unknown factors that could influence any results. If this model is to be tested, any approach taken will need to be carefully evaluated to ensure as unbiased a result as possible is obtained.

5.1 An evaluation approach to testing

Evaluation is oriented towards assessing and improving any given object, programme, system, theory and most other entities (Stufflebeam and Shinkfield, 2007). Evaluation provides a gauge, and often assesses the value of an object for the benefit of a user/consumer. There are two broad categories of evaluation: formal and informal (Clarke, 1999), distinguished by the means with which they are conducted. Informal evaluation occurs on an almost daily basis, judging the value or worth of a purchase for example. Formal evaluation, however, is a disciplined form of inquiry that applies to the collection and analysis of information (Lincoln and Guba, 1986). Formal evaluation can be defined as:

‘the systematic process of delineating, obtaining, reporting, and applying descriptive and judgmental information about some object’s merit, worth, probity, feasibility, safety, significance, and/or equity’ (Stufflebeam and Shinkfield, 2007)

This definition highlights the importance that perceived value plays in evaluation, and subsequently the role of subjectivity and judgement. In the context of knowledge management theory, it is likely that safety is not a useful indicator for evaluation. This definition ignores the differences that exist between the different indicators: merit, worth, probity etc. An object’s success is defined against its purpose, but an object’s merit, worth or significance is measured against the requirements the object serves (Scriven and Coryn, 2008). These distinctions are necessary when it comes to creating the evaluation framework.

Within formal evaluation there are two different, and complementary, evaluation techniques: formative evaluation and summative evaluation (Stufflebeam and Shinkfield, 2007). Formative evaluation focuses on the process of improvement and about identifying strengths and weaknesses (Clarke, 1991). Summative evaluation, on the other hand, is concerned with post process decision-making and has a focus on providing information to make a decision for action (Clarke, 1991). The evaluation necessary for this research was formative because the aim is to improve or ensure the quality (Stufflebeam and Shinkfield, 2007) of the autopoietic model of knowledge. It might appear that summative evaluation is more appropriate, with its focus the completion of a programme, process or product; however, summative evaluation does not allow the clarification of goals or debate surrounding the nature of any implementation (Clarke, 1991).

5.2 Evaluation in Knowledge Management

Knowledge management, with its numerous ‘best practices’ and ‘lessons learnt’ is a suitable candidate for an evaluation methodology (Patton, 2001). The lack of a confirmed definition of knowledge creates uncertainty within knowledge management, which also favours an evaluation methodology. Specifically within knowledge management, an evaluative methodology is especially suited towards model testing, theory testing, measuring outcomes and generating lessons learned (Patton, 2001). Evaluation should be ideal for testing the autopoietic model of knowledge.

The abstract, and necessarily unmanageable nature of knowledge (Abou-Zeid, 2007) means positivist, critical or post modernist approaches to testing are not suitable because they require the existence of an objective, independent reality. Only an interpretivist approach is suitable, of which evaluation is one technique. Evaluation is the best approach for allowing participants to determine the place of the autopoietic model of knowledge among existing models and theories, as well as determining the model’s potential practical applications. Other interpretivist approaches could have been used, but lacked the structure possible with an evaluation framework (Scriven and Coryn, 2008).

When using an evaluation methodology, it is necessary to provide a framework to guide the process (Scriven and Coryn, 2008). Adapting the guide for creating a framework from Scriven and Coryn (2008), the necessary framework for guiding the evaluation is shown in Figure 2.

Determine the evaluator's definition or understanding of the terms used in the model. Determine whether the evaluator perceives all elements of the model as equal, or whether some elements are more important. Determine whether the evaluator agrees with the relationships present, and whether any relationships need adding. Determine whether the evaluator feels any elements can be measured. Determine whether evaluator agrees with model, if not, determine necessary changes through a second round.

Figure 2: The evaluation process

Evaluating in knowledge management yields one major problem: how to account for the different perspectives, or paradigms, the evaluators may have, whether it is information science, philosophy, psychology, management studies or sociology (Jashapara, 2004). Rather than becoming an obstacle, the key to a successful evaluation is to 'make evaluators more aware of their methodological biases and paradigmatic assumptions so that they can make flexible, sophisticated, and adaptive methodological choices' (Patton, 1988). Once the evaluation process from Figure 2 has been followed, it is subsequently necessary to determine the philosophical position of the evaluator, and determine how the model, or indeed the process just followed, might be different. Along with the philosophical perspective, factors such as the duration of time the evaluator has been working in knowledge management were taken account of. The evaluations were conducted individually by interview.

5.3 Question rationale

Questions for the evaluation were split into five parts, each with a different purpose. First, a series of demographic questions were asked at the start as a means of adding background to the responses received. Respondents were asked their gender (Q1), age range (Q2), occupation (Q3) and the time they had spent in knowledge management (Q4). Respondents were also reminded of their rights under the ethical research policy.

Part A questions were asked before showing the participant the autopoietic model of knowledge. The questions were used to determine the respondents' current perspective or understanding of the concepts involved in the new model of knowledge. Q5 was an important starting point because the new autopoietic model of knowledge removes the concept of information; and just uses data and knowledge. Acceptance of the new model of knowledge depends heavily on the degree to which users are able to change long held beliefs. Q6 was a slightly more academic question because it returns to the notion that knowledge; truth and wisdom are three highly connected concepts, or indeed just three perspectives on the same object. Q7 started to make the link between theory and practice by exploring the potential for overlap, whilst Q8 started to look in more detail at the use for a model of knowledge in knowledge management.

- Q5 – What is your understanding of data, information and knowledge and the relationship between them?
- Q6 – Do you see a role for wisdom and truth in your previous answer?
- Q7 – How important do you think a definition/model of knowledge is to knowledge management? (Cover definition of knowledge management)
- Q8 – What use do you think a model/definition has in knowledge management? (Difference for theory/practice perspective?)

Part B was concerned with capturing the participants' first impressions about the autopoietic model of knowledge before it was explained in detail. This was a vital stage since it meant the participants' reaction and initial perspective on the model could be recorded. This stage also allowed the user to experiment with the model freely and determine whether, by themselves, they could apply the model to their own working practices. The model was then explained to the participant, covering details about the terms and concepts in the model, the relationships, its development and finally its potential uses.

- Q9 – What are your first impressions of the model and why? (terms, definitions, relationships)

Part C was concerned with the participants' views on improving the autopoietic model of knowledge. Q10 started this process by first confirming the participants' understanding, and agreement with, all the concepts used in the model. Q11 followed by exploring the participants' views on the relationships in the model. This was a necessary step because knowledge management as a discipline already contains disagreements that stem from semantics, and to avoid terminology becoming a problem, it was necessary to tackle it as an issue early on in the evaluation process. Q12 started to look at shortfalls in the autopoietic model and knowledge, and clearly asked the participant if they thought anything was wrong or missing from the model. By this stage, the questions were starting to help the participant place the new model of knowledge in the existing literature and their own view of it. Q13 started to address the issue of whether the potential exists to measure or test any of the elements or relationships in the model, which is clearly follows??? a formative evaluation methodology. Q14 ended by getting the participant to consider how the model might be different if other theoretical positions were considered. This question depended on answers previously given.

- Q10 – Do you agree with the meanings associated with each term in the model and why?
- Q11 – Do you agree with the relationships present in the model and why?
- Q12 – Is there anything you think is missing from the model and why?
- Q13 – Do you think any of the terms could be measured or tested?
- Q14 – How do you think the model would be different if …? (question depends on answers given previously)

The final set of questions follow a summative approach because of the focus in using the model as a way of explaining the working practices of participants. Q15 started by explicitly asking participants to consider how the model might explain their current working practices, with Q16 following up with examples. The opposite to Q15 is Q17 which looked at where the autopoietic model of knowledge potentially fell short in its ability to explain working practices. Whilst Part D questions carried a different focus from Part C questions, both parts are necessary because Part C was concerned with testing and improving the autopoietic model of knowledge, but Part D was concerned with applying the autopoietic model of knowledge to the participants working practices.

- Q15 – How do you think the model fits into your current working practices?
- Q16 – Can you think of any examples of when you might/do follow the model?
- Q17 – Is there anything in your working practices that is not, or cannot be, explained by the model?

6. The pilot study

The pilot study was successfully conducted with two academic researchers and one knowledge management practitioner. The main purpose of the pilot was to ensure the evaluation instrument could be successfully deployed, with no problems, mistakes or other inaccuracies. The final results collected will be subject to a thematic analysis for each art of the evaluation. For now, this paper reports on recommendations from the pilot study for carrying out the main study.

Deciding on the composition of the evaluation team, variety is perhaps the most important factor, especially given the vast philosophical perspectives that can be found in knowledge management (Jashapara, 2004). There appears to be three key dimensions on which the evaluators could vary: length of active time in knowledge management, philosophical perspective and whether the evaluator is a practitioner or theorist (researcher). A selection of evaluators across all dimensions provides the best representation for a balanced evaluation.

6.1 Recommendations for the main study

Several recommendations came from the pilot study. First, it was necessary to provide a prepared set of definitions for the terms in the model, as opposed to explaining the terms, potentially differently, for each respondent. This later helped to ensure that all respondents received the same explanation of the same model, as opposed to being swayed by different explanations of the same model. Second, respondents also found it easier to understand the model when labels were added to the arrows. Respondents felt the labels made it easier to define the relationship the arrow represented, and what data was flowing along them. Third, the time the respondent had spent in knowledge management was also slightly problematic in the pilot study. All respondents were currently working under the title of knowledge management, however past careers still involved KM activities, but not necessarily under that title. The main study will need to ensure respondents distinguish between time spent directly under KM and time spent working under other titles. Finally, the initial questions did not make clear that the respondent should answer according to their own personal belief, and not their organisation's viewpoint, or their teaching viewpoint. This initially lead to some confusion on the part of the respondents, but after clarification it was possible to collect the required responses.

6.2 Example of model in use: creating a lawn drainage system

After conducting the first evaluation, it became clear that asking respondents to evaluate a model with which they had just been presented was a complex problem. Discussion with the evaluators revealed that a case study, or scenario would help them to apply the model and see it in use. A scenario was carefully crafted to show how the whole model was used (Figure 3). This was deemed preferable to trying to apply it to an example provided by the respondent since it allowed a consistent presentation of the model to all respondents. The case study was also carefully selected to ensure it was in a domain that was unrelated to the work done by any of the respondents.

> One autumn, you decide (action) to take a walk in your garden before winter sets in (knowledge). It is still daylight (allows you to distinguish the grass and everything in the garden) and you can see the grass is perhaps a little wet (observation). You know that it has rained recently (knowledge) and because that is probably the explanation, you take no action at this time. Entering the garden (action), you notice (distinction) that the ground is soggy (observation) and must be waterlogged (knowledge). Trying to work out why (question) your garden is waterlogged, you notice the surrounding gardens drain into yours (observation). You decide you know how to dig (knowledge) and possess the right tools, so dig a drainage ditch in your garden to try and solve the problem (action) and decide to wait a week to see the result. By this point, you know your soil is clay based (knowledge) and that it hasn't rained all week (knowledge). You need to assess (question) whether the problem still exists so go back into your garden. It is light outside (observation), so you know that is a suitable time to assess the situation (knowledge). Standing on your grass (action), it is possible (distinction) to deduce that the ground is still waterlogged (observation) and you know the drainage ditch has failed (knowledge).

Figure 3: Case study to demonstrate the model in use

7. Conclusion

This paper has presented the findings from a pilot study evaluating an autopoietic model of knowledge. The rationale for the questions used were presented, and showed the breadth and scope necessary to fully evaluate the model and explore its potential implications. The pilot study was then discussed, along with the recommendations for the main study. It was discussed that it is necessary to present all participants with the same definitions and labels, as opposed to having the concepts explained differently each time, as well as presenting a case study to show the model in use. Following a successful pilot study, it is now possible to continue with the main study, for which the KM experts will first need to be selected.

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