Architecture of three-dimensional knowledges in the discipline of leadership

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Abstract

In this paper we present two related results. The first is a model of personal knowledge which is based on the number of dots the person can see, and thus the dimensions of knowledge. E.g. one dot indicates dimensionless knowledge, two dots indicate one-dimensional knowledge, then the three dots for two-dimensional knowledge, and the highest knowledge level is the three-dimensional knowledge indicated by four dots. Based on qualitative examination of this model we determine which part of deliverable knowledge is appropriate for e-learning at the different knowledge levels of the teacher. The second result builds on this one; it is architecture of three dimensional knowledges in the discipline of leadership, particularly it covers the part appropriate for e-learning. To present this second result we use our next generation knowledge visualization tool, Knowledge Galaxy[1].

Keywords: architecture of knowledge, knowledge levels, curriculum development, leadership, Knowledge Galaxy

Introduction

There are two results presented in this paper: a new conception of knowledge, according to which we have built a model which describes the knowledge levels according to the number of dots the person sees and the relationship of between these dots. This model provides a comprehensive explanation of the qualitative differences between the knowledge levels. The second result is the architecture of three dimensional knowledges (from the first result) in the discipline of leadership to be delivered by e-learning.

Before turning to the presentation of the results, in the first section we describe how our interest in the knowledge of the leader arose; this first section contains a subsidiary result, namely a new type of knowledge is added to Ryle‟s (1949). Then there are two sections subsequently dedicated one to each main result.

We adapt an unusual starting point to this research, namely the ancient wisdom of Hermes Trismegistos. This is not a scientific starting point indeed but this is in complete coherence with our anti-methodological approach adopted from Feyerabend (1993): "Anything goes." Apart from speculation and discussion we also used ex-post unstructured phenomenological observations from our extensive experience in teaching and consulting, as well as thought experiments.

The knowledge of the e-leader: "knowing what"

Our inclination to examine the knowledge of the e-leader (the „e-" refers to e-age, i.e. the e-leader is the leader of today) evolved from several sources in parallel. Having worked as consultants for a num-

[1] http://www.knowledgegalaxy.com/

ber of business leaders we have learned a lot about the knowledge of the e-leaders; however, this knowledge was not systematized and it was also mostly tacit. This paper is partly an attempt to start systemizing our knowledge about the knowledge of the e-leader. The other source of our interest is that we have discovered that the role of leadership is changing, as it is briefly outlined in this section. The trigger to put this and our new conception of knowledge modelling was our examination and further development of Ryle‟s (1949) knowledge model.

Ryle (ibid) asserted that not all knowledge can be described as a set of facts and propositions, namely that there is also the knowledge of how we do things, which we cannot necessarily formulate as a list of propositions. Ryle calls the former "*knowing that*" and the later "*knowing how*". Anderson (1983) arrived at the same categories of knowledge but coined different names for them; he calls the "knowing that" *declarative or descriptive knowledge*, and the "knowing how" he named *procedural knowledge*. According to the "intellectualist legend" (Ryle, ibid, p. 26 ff) an action can only be considered intelligent if and only if the person is thinking what (s)he is doing while doing it; so the intelligent performance involves observation of rules or application of criteria. It follows that the person first must acknowledge the rules or criteria, and then devise a plan about what is to be done. Borrowing Ryle‟s (ibid, p. 30) example this would mean that:

> "*The chef must recite his recipes to himself before he can cook according to them.*"

This is, of course, nonsense. Let‟s stick to this example of the chef a bit longer. The knowledge of the problem solver when creating a novum can be described as "knowing why"; Gurteen (1998, p. 5) also uses a cook as an example: if there is an ingredient missing from your cake, knowing why that ingredient was part of the recipe might help you finding a substitution:

> "*In fact, know-why is often more important than know-how as it allows you to be creative – to fall back on principles – to re-invent your know-how and to invent new know-how.*"

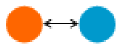
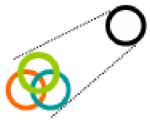
It is worth staying even longer with this example of the chef: he can make a haggis and a strawberry truffle (amongst others) without reciting the recipes to himself, as he "knows how". But, which one to make tonight for her? This is different from knowing how to make them or why to make them. This is knowledge about what to do – this new knowledge category we can call "*knowing what*". This is the kind of knowledge the leader needs. The next section introduces our new conception of knowledge as it can be modelled using dimensions – the discussion is, of course, focused on leadership.

A new conception of transferable knowledge

The starting point of our new conception of knowledge is probably unusual for a scientific article: it is the ancient wisdom of Hermes Trismegistos; he explained the world using numbers 1-9, 1-4 indicate what is in our world, 6-9 describe the transcendental world and 5 mirrors the one to another. Here we use 1-4 to describe the levels of knowledge. There was an additional starting point, namely Marcuse‟s (1964) "One-dimensional man". In our new model of knowledge we distinguish four classes of transferable knowledge (**Table 1**): In the first class belong people seeing a single point; the name for the class offers itself: dimensionless knowledge. In the second class we see two points and their relation, a line that connects the points. It is easy again to find a name for this class; two points determine a line, which is one dimension; thus this class is called one-dimensional knowledge. To have a harmony in the solution it is obvious that the third class should be called two-dimensional and the fourth three-dimensional knowledge. There are very few people who can envisage four dimensions, thus there is no reason to have a fifth class, viz. four-dimensional knowledge.

Although it was not the original intention, during the examination of the model we have discovered that our new model is also consistent with the previous models of knowledge levels. Dreyfus and Dreyfus (2000, pp. 19-36) gave a qualitative description of knowledge levels. Mérő (1990, pp. 119-121) added a qualitative description by positioning the knowledge levels according to the number of cognitive schemata. The first description does not provide much in terms of indicators according to which the knower can be classified and the second is perfectly accurate but it requires a lot of effort to estimate the number of someone‟s cognitive schemata in a certain discipline. Our new model is qualitative and it also provides tangible and easy-to-use indicators to classify the knower as well as easy understanding of the qualitative differences. Our model appears to be completely consistent with the mentioned two models, although there is no conclusive evidence yet about this.

Table 1: Teaching-learning according to the knowledge of the educator.

	0-D knowledge *presenter*	1-D knowledge *instructor*	2-D knowledge *lecturer*	3-D knowledge *master-professor*
model of knowledge[2]				
elements of knowledge[3]	doctrines	two keywords connected by a causal relation and a method	three keywords and four[4] (3+1) intersections	three keywords, four intersections and a meta-concept
amount of[5] knowledge	12x1=12 elements	(12x2)+(12x(1+1))=48 elements	(6x3)+(6x(3+1))=42 elements	(4x3)+(4x1)+(4x4)=32 elements
knowledge transfer	E-learning 0%	E-learning 50%	E-learning 43%	E-learning 37%
knowledge of the learner[6]	list of doctrines	list of isolated relations and methods	set of concepts	meta-knowledge (essence)
applied knowledge	repeating the doctrines (facts)	accomplishing tasks	managing processes	creating solutions (seeing what nobody has seen)
knowledge media and authors	several authors HANDBOOK		single author TEXTBOOK	team of authors led by a master BOOK

In our model, the knowledge levels are described by the number of dots which the knower can „see". In reality the there is a smoother transition between the levels; here only the pure types are introduced.

The knower at the lowest knowledge level may see isolated dots only, which correspond to isolated facts or doctrines presented as facts. This we call the *dimensionless (0-D) knowledge*. At the second level the knower sees two dots at the same time and can connect them by a directed relation, such as causal relations or logical „if... then" rules. Along these relations methods can be devised, i.e. we can learn how to get from one point to another. As two dots determine a line this we call the *one-dimensional (1-D) knowledge*. It can be expected that the next level should be called *two-dimensional (2-D) knowledge* and be described by three dots. If one sees three dots the simple relations from the previous level will prove poor for providing satisfactory explanation. Thus we describe this knowledge level with three sets in intersection. This does not mean, of course, that on this level the knower cannot handle e.g. causal relations (any two from the three dots may be connected by an arrow); this means that here we can have a richer picture of less rigid relations, such as intersections. The highest level of knowledge presented here is the *three-dimensional (3-D) knowledge* corresponding to four dots. We know little so far about the 3-D knowledge but there are several details observed. The fourth point is qualitatively different from the previous three; it somehow throws light to the previous three through their interrelations (this is why there are fewer elements at this level than at the previous one). There is no much sense to try to describe higher knowledge levels – very few of us can imagine pictures of more than three dimensions. The development from one knowledge level to the other is, of course, gradual but here only the pure characteristic forms are used. In the present paper only the knowledge

[2] A particular topic is described by keywords and their relationships.

[3] Another proof for the capacity limit of STM – there can be no more elements than 7±2. (Miller, 1956)

[4] The four intersections in two-dimensional thinking do not mean the same as in the three-dimensional thinking. In two-dimensional thinking the „fourth" intersection is only a special case; thus it is said to be „3+1". At the same time in the three-dimensional thinking it is something new, often the representation of or a shortcut to the essence.

[5] Assuming 12 weeks in a semester.

[6] The new knowledge that a talented student may achieve.

of the educator is used as a point of reference but in application we also must take into the account that the learner can only perceive teaching delivered one level higher than her/his existing knowledge (meaning that the delivered teaching cannot be higher than that; it can always be lower – but why would we do that?)

We shall now examine somewhat more closely how much of knowledge at different levels can be transmitted in one semester. The explanation is summarized in row 2, 3 and 6 of **Table 1**. For this we assume 12 weeks in a semester and that the teacher can transfer in one block[7] only what can form a single whole in her/his mind.

The presenter with 0-D knowledge can do nothing but citing doctrines, which (s)he will present as facts. For example, a presenter may provide her/his students with list of leadership roles – with no connection between them. One lecture can cover one doctrine, as in 0-D knowledge there are no connections between the knowledge elements and thus more than one element would not fit into a single whole. So, at 0-D level, 12 doctrines can be delivered in a semester – and the learners will end up reiterating these doctrines. If they learn something more it is due to their talent or previous knowledge. The high performance at this level can be described as *precise*.

1-D knowledge provides delivery of two keywords with a relation between them and a method based on this relation. These four pieces can form a single whole in the mind of the instructor, so (s)he can deliver 4 pieces each week, which makes 48 pieces within a semester. Examples for this kind of knowledge delivery may include the instant ways of improving motivation. The learners of such courses will be able to accomplish well-defined tasks according to the learned recipes – and will wonder why the instant solutions very often do not work. The high performance can be described as *efficient*.

In the 2-D knowledge of the lecturer a unit could consist of three keywords and four intersections representing the relations, which are more complex than those on the previous level. However, if the new knowledge would be delivered at the pace of 7 elements each class, one can hardly believe that the students could keep up.[8] Therefore, the 12 weeks are here divided; delivering 3 keywords on 6 occasions and 3+1 intersections on other 6 occasions. Therefore, the students will receive a smaller amount of knowledge (42 pieces) than on the previous level but it will be of higher complexity. Such teaching means e.g. explaining the role of values and knowledge in teamwork.[9] The student, who learns all that is delivered, will be able to manage some processes, in the present example teamwork processes regarding knowledge and value systems. There will be a limit to this managing and the student will be able to recognize these limits but will have no chance to do something beyond the limits. The high performance can be described as *effective*.

The master-professor‟s 3-D knowledge consists of four dots, three of which are the keywords and the fourth we call the meta-concept. However, the relations that are presented here are not between the four dots directly but between the meta-concept and the intersections of the keywords. We could say that through the intersections the meta-concept illuminates the keywords. These pieces can form a single whole in the mind of the master-professor – for her/him it is all contained in the meta-concept. This level of knowledge delivery is barely structured and thus it is difficult to grasp. We can only observe that the master-professor often uses parables (sometimes from a totally different domain) to illuminate what (s)he wants to say; i.e. the meta-concept often takes the form of a parable. This knowledge is of extremely high density, so we divided the 12 weeks into 3 chunks this time. On 4 occasions there will be 3-3 keywords delivered; on other 4 occasions a meta-concept will be introduced on each; finally on 4 occasions the relationships between the meta-concept and the 4 intersections are described. This means altogether 32 pieces of knowledge in a semester. An example can be if the mas-

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[7] Regardless if a block means 2 or 2×2 hours of teaching time.

[8] Our previous research suggests that, regardless to the length of the class, max. 3-4 pieces of new knowledge can be delivered to the learners.

[9] These keywords will also appear in a forthcoming example but each of them will belong to a different topic. By putting them in a different order we want to illustrate that there is no single right way.

ter-professor explains the example from the previous paragraph using a story of Herodotus, of the top executive (s)he had a lunch with, or of the yesterday‟s reality show. The talented students will have a better understanding of knowledge, value systems, and teamwork – not necessarily being able to put into words how they understand them. The high performance ***cannot be described***. But ask them for help if the students from the previous paragraph got stuck managing their processes – these guys may have some ideas.

This section aimed to provide brief description of our new conception of knowledge levels aiming to understanding of its general characteristics rather than the details. It was already indicated in the present section which amount of knowledge can be delivered at different knowledge levels of the educator; the next section focuses on what e-learning can be used for in these cases and how such an e-learning may be structured.

E-learning in the discipline of leadership

Each year 50-60 billions of dollars are spent for trainings of employees in government institutions of the USA. Is e-learning going to change the paradigm of knowledge increase of business professionals? 5-6 years ago Jack Welch and John Chambers labeled e-education the most important phenomenon since the industrial revolution. What has not changed due to the industrial revolution is that we cannot artificially (re-)construct a process that we do not know. This assertion can be modified to say: „we cannot construct any process that we cannot model‟, i.e. that we cannot envisage. This is an important question, as in e-learning we try to replace the known teaching-learning process with another one. It would be a mistake to think of e-learning as of a sum of the internet and of the teaching-learning system. We give a brief description of how we perceive e-learning before turning to introduce our conception of architecture of curriculum of leadership.

It is important to use the appropriate methods for knowledge transfer accommodating psychological processes of people and making use of available technology. When the limits of cognitive processes are neglected the e-learning using all the available technology to transfer text, voice, and picture may slow down the learning. The reason for this is the limited capacity of simultaneous information processing of people. (Miller, 1956) Technology can easily transfer more sensory information than our nervous system can process. According to Clark and Meyer (2003):

> *"Our cognitive systems have limited capacity. Since there are too many sources of information competing for this limited capacity, the learner must select those that best match his or her goals. We know this selection process can be guided by instructional methods that direct the learner's attention."*

In e-learning the dropout rates have been estimated as high as 35% (as compared to the average dropout rate at US universities at 20%). (Svetcov, 2000) These statistics allow different interpretations. In many cases the user simply needs only a part of the offered knowledge and (s)he does not intend to accomplish the whole course. Still, the remaining cases can be explained in different ways from the boringness of lectures to the lack of the „school ambient‟. E-learning requires self-control of sitting at the computer. Recently we can more often observe the other way of the lack of self-control: the users cannot be detached from the computer; thus this excuse is only applicable to the boring lectures. We consider that the interestingness of the lecture is up to the author and thus her/his knowledge determines what can be transferred. This outcome is pretty similar to what we experience in classroom-learning, is it not?

From the model in the previous section, it is easy to see implications about the usefulness of e-learning at the different levels. E-learning is appropriate media to deliver keywords: it is superfluous for the knowledge elements of lower complexity and inappropriate for those of higher complexity. Thus the 0-D presenter cannot make use of e-learning. The best use if e-learning is made at the 1-D knowledge level of the instructor (24 keywords = 50% of all), i.e. by replacing handbooks in education of task accomplishers. Somewhat less at the 2-D knowledge level of the lecturer (18 keywords = 43% of all), i.e. replacing the textbook for those, who will manage the processes. The e-learning is of even less use at the 3-D knowledge level of the master-professor (12 keywords = 37%), although this time it is not replacing the book – it is something else. To the students, who want to engage with problem solving, we suggest doing both: reading the book and using the e-learning.

Now we shall see how this conception can be used in architecture of a curriculum for leadership. The starting point here is that we already have the body of the curriculum; i.e. we know what knowledge we want to deliver and the only remaining thing is to structure it. Firstly, we have to divide the curriculum into wholes of four topics with three keywords for each. The assumption is that we want to deliver the essence, i.e. three-dimensional knowledge; we also have to pay attention to maintain a correct taxonomy. This last requirement implicitly contains the acknowledgement that there is no single right way of creating taxonomies. Most libraries arrange their books either alphabetically, or by subject, or chronologically. There are, however, numerous other ways to do it; e.g. Thomas Jefferson shelved his books by size. This suggests that it is impossible to define one single keyword by which a particular book can be categorized. Borrowing Foucault‟s (1972, p. 25) example:

> *"A novel by Stendhal and a novel by Dostoevsky do not have the same relation of individuality as that between two novels belonging to Balzac's cycle La Comédie humaine; and the relation between Balzac's novels is not the same as that existing between Joyce's Ulysses and the Odyssey."*

So we do claim that our taxonomy presented here is the only possible architecture of curriculum of leadership; it is only one way of doing this. For instance, HBR ("Harvard Business Review Online", n.d.) divides leadership into the following four topics: (1) management styles, (2) personal strategy & style, (3) power & influence, (4) vision. One division is not better than the other; they are only different. This, of course, does not mean that any taxonomy will do, we need a comprehensive and cogent taxonomy. In a recent book on leadership we had the following parts (i.e. two levels of topics 4×4):

Homo eticus
- quick decision
- delegation
- decision capability
- value-based decision

Homo informaticus
- e-age
- e-learning
- artificial intelligence
- knowledge

Homo charismaticus
- leader
- new environment
- vision
- power

Homo creativus
- master
- problem recognition
- solution
- teamwork

By adding keywords to each topic we get the knowledge map (Figure 1). The content will be attached to keywords; each will be described by a text (cca. 500 characters), two speeches (one speaker talks about the „main‟ material and the other delivers a story), a moving picture (flash), and test questions. For each topic a common sense story will be attached to connect the model of functioning to the existing knowledge of the users. (Figure 2)

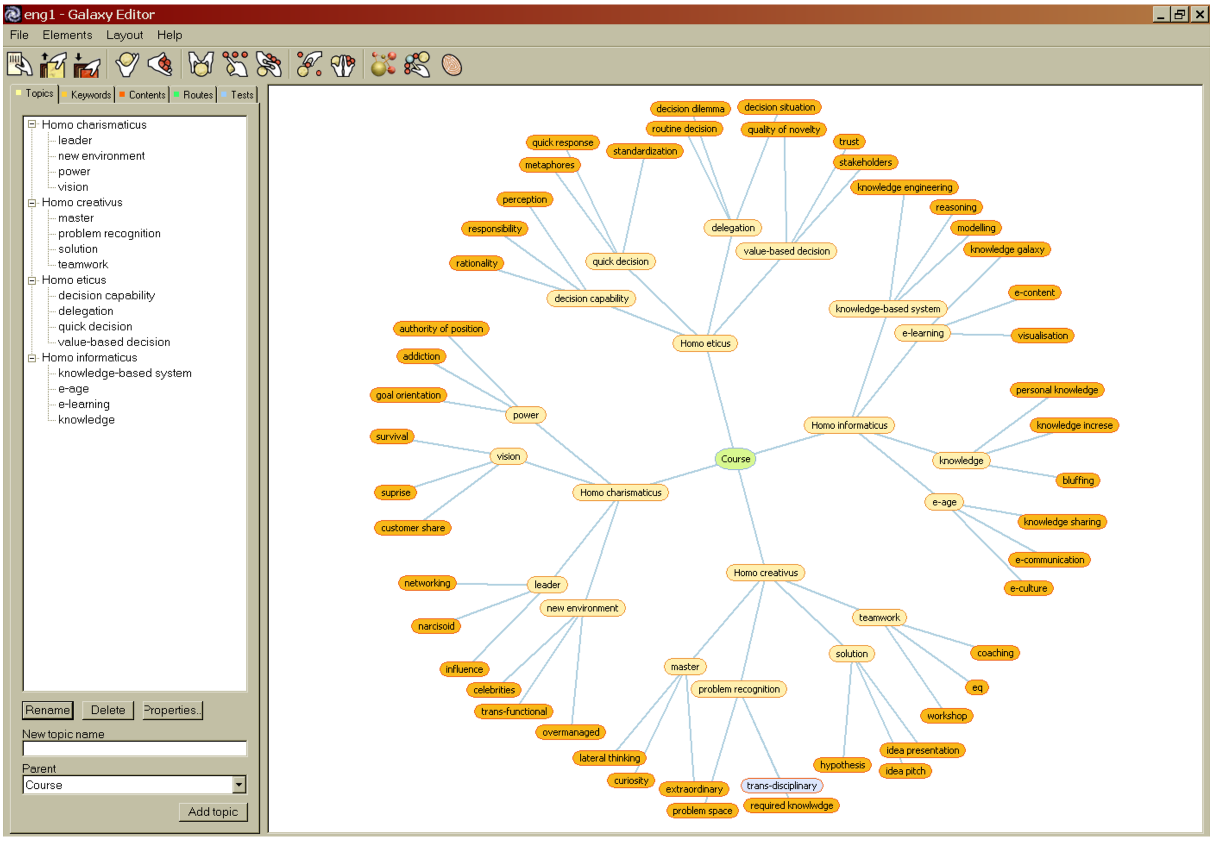

Figure 1: Knowledge map of leadership decision making.

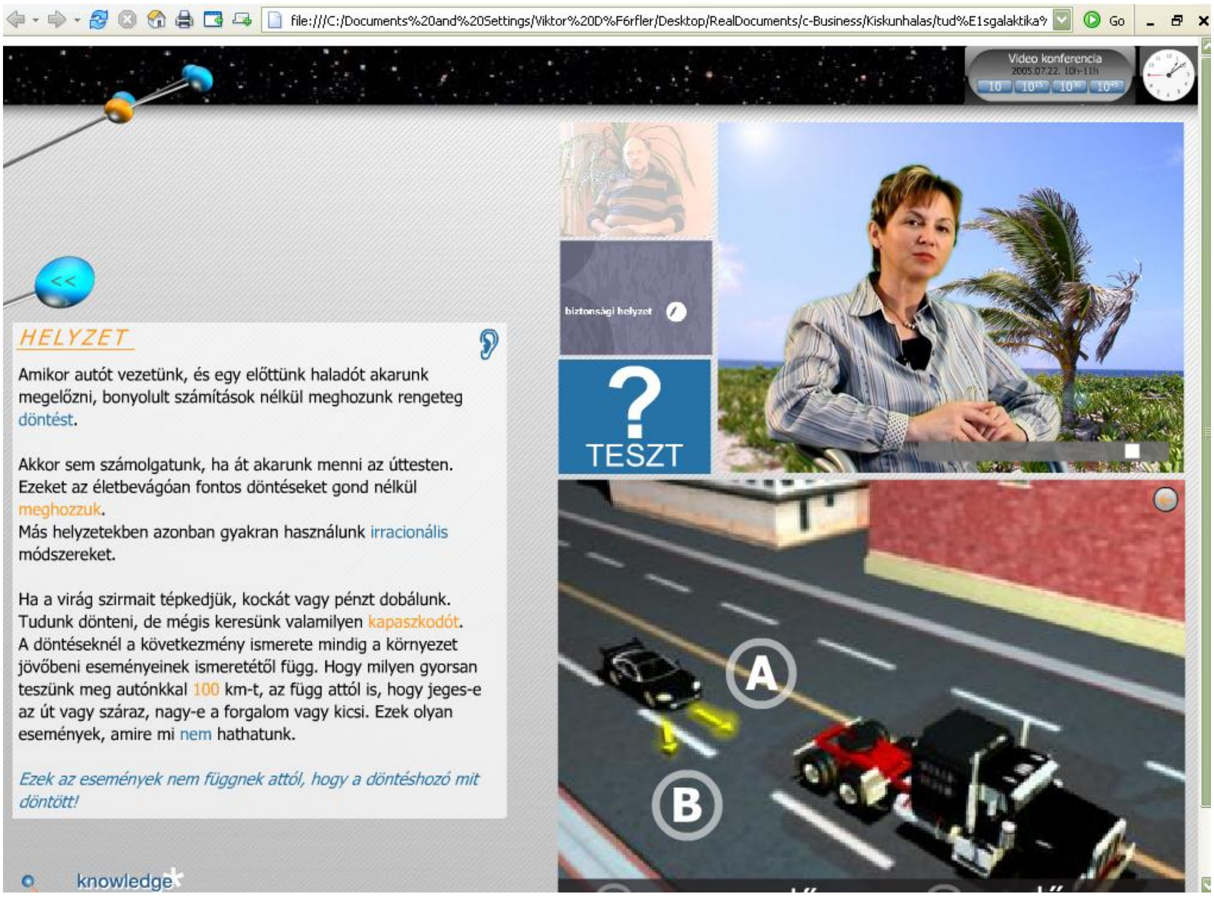

Figure 2: A keyword in the Knowledge Galaxy.

In our Knowledge Galaxy, the topics and keywords are not in a sequential order, which enables the learners to choose their individual, most suitable learning route. This way, learners can apply any kind of order to access keywords. Learning routes reflect the diversity of cognition which is presented by the tangle of the Knowledge Galaxy.

This solution can satisfy the two basic requirements without which we cannot speak of e-learning: the multimedia and the interactivity.

Conclusions

Two major results were presented in this paper: a new conception of knowledge based on dimensions indicating the knowledge levels, and based on this the architecture of three dimensional knowledge curriculum of leadership, particularly the part that can be delivered using e-learning.

The first result was achieved using an unusual starting point and, for a long part of the research process, the work was purely speculative. However, once we have achieved the result, we have compared it to our teaching experience of few decades, using unstructured phenomenological observations and thought experiments. We have also found that our model is coherent with other models about knowledge levels. Its significance is that it provides comprehensive explanations of the qualitative characteristics of the knowledge levels and it can also serve as basis for developing indicators to help classifying knowers.

For the architecture of three dimensional knowledge curriculum of leadership we used, apart from the first result of this paper, a conception of e-learning developed from a cognitive, rather than technological, standpoint. We also indicated, although very briefly, our approach to taxonomies which underlies the taxonomy developed here for leadership. This architecture of three dimensional knowledges is designed to be delivered using our new generation knowledge visualization tool, Knowledge Galaxy. The benefits of the software can be summarized in four key points: (1) transparency of the curriculum architecture is available through the galaxy of keywords displayed in 3D; (2) flexibility of the learning route, i.e. students may choose their own order of acquiring the content by navigating in the galaxy of keywords; (3) self-test is provided to enhance awareness of the advancement in learning; and (4) automated monitoring of learners' performance by recording the time spent on particular keywords and by recording the test results.

Suggestions for further research

There are many ways of further research based on the present paper. We have an ambitious plan for the first result: it should be one of the starting points of a dynamic model of knowledge that would also be appropriate for examination of knowledge increase. A first step into this direction is to acquire a more detailed knowledge about the transition between the knowledge levels as described here.

This paper did not focused on general problems of taxonomies but it is acknowledged that we do not have acceptable criteria to evaluate the different taxonomies; our first idea here is to try to develop a fitness-type evaluator based on evolutionary approach. We do not believe that it is possible to achieve translation between the lexicons but some useful results may be achieved by better understanding of the evolutionary nature of ontologies. Similarly to this problem of ontologies we do not have means of evaluating curricula in terms of architecture of knowledge.

Finally, there is a cluster of problems which do not fall into domain of science but into domain of software development. It is out of scope of this paper to detail the problems belonging here but they are of various sorts, such as design and ergonomy, regarding both the teacher and the learner side.

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