The Importance and Value of Knowledge in the Context of Informatization: The Problem of Knowledge Fragmentation

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Abstract **– This article attempts to explicate importance and value of knowledge in the context of informatization, while focusing on the problem of fragmentation of human knowledge in connection with the application of ICT in the process of education (or the process of learning). The illustrative research uses quantitative research method. A questionnaire survey was carried out on a sample of respondents (n=342) described in the paper. An interpretative critical analysis is based on existing sources as well as on data from our own investigation. Based on the analysis the authors present how informatization contributes to the fragmentation of individual knowledge. The article includes the model of importance of knowledge and a (general) theoretical concept that should enable a better understanding of the subject matter. A necessity therefore arises for an adequate reaction of the education system, as well as each individual, to the conditions changed by informatization. The authors present their main recommendations on how to react to the changed conditions at the area of education.**

Keywords **– knowledge, piece of knowledge, data, information, education, thinking, information society.**

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1. Introduction

The aim of the present article is to reflect the role of knowledge in the information society and to introduce the results of research that intended to examine the effect of informatization on the value of knowledge. Given the breadth of the topic, the article focuses on addressing the research question formulated in the following paragraph. Since the justification for carrying out a research is not merely its non-existence, it seems appropriate to briefly mention the motivation of the authors.

Conducting this research was motivated firstly by the inhomogeneity and ambiguity of the theoretical interpretation of the topic, which, moreover, insufficiently accentuates the nature and the importance of individual knowledge. Thus, the concept led us to problems in formalizing the subject area in question. Secondly, it was motivated by the existence of inspiring concepts (e.g., [1], [2], and [3]), which, however, would benefit from being further developed or even approached from an interdisciplinary angle and from the perspective of informatics. Another motivating factor could be seen in certain skepticism (of the authors) in relation to some observable (or observed) phenomena connected with the conception of knowledge and education in current practice (in the context of informatization). The defined issue suggests considerable interdisciplinarity of the article, both in terms of the interdisciplinary character of approaches and the interdisciplinary relevance of the conclusions.

The article attempts to answer the following research question: *Can informatization contribute to the fragmentation of individual knowledge and thus negatively affect its value?*

The structure of the text is as follows. After this introduction, a brief overview is given of the theoretical and methodological fundaments, which not only defines the terminology, but also – more importantly – presents in context the conceptual

foundations. An overview of the research method applied here is then followed by a presentation, which comprises results of the illustrative research. Based on these, a conceptual model of importance of knowledge is presented that summarizes the fundamental interpretation of the term knowledge. Finally, the article presents the discussion and provides insights, which then allows the authors to formulate their conclusion.

2. Theoretical Background

As suggested above, article thematic and theoretical scope is inspired by the ideas of Liessmann [2], Spitzer [3], Carr [4], Chomsky [5] and others, namely the already 'classic' works of Fromm [1] or – from the Czech environment – the works of Brouk [6], which the authors continue to develop. In terms of theory and methodology, the paper adheres to the systems theory [7], [8]. The impact of informatization on knowledge is handled in the literature from the perspective of organizational informatics, or knowledge management [9] but equally important for the following exposition is a reflection on the issue from the standpoint of education and information science [10], or other multidisciplinary ventures, such as [11] or other substantial contributions within the individual (related) disciplines, e.g. [12]. Other important sources for creating a theoretical plan are given below.

The origin of the term information lies in the Latin word 'informare', which means to give shape or form to something. It is a "potential structure capable of the act of in-formation (reprinting from one system to another)" [13], in which the subject is able to transform, to interpret. Information is therefore something that internally 'in'-forms us. It should be noted that [14], for instance, approached in an interesting way the relation between information and an ontological understanding of the whole. He understands the term 'information' in terms of 'Aristotelean' informing, which means that receiving a piece of information may lead, on the side of its recipient, to a transformation of his or her ontological model of the world as a whole. Data, as opposed to information, only 'fill in' empty intentions directed towards facts. In this context, some authors (e.g. [15]) talk about the existence of the so-called 'exformation', this does not inform us – the products of the current information saturation – but rather stays outside ourselves. Gore [15] uses the term exformation for information junk, the data that lie outside the human brain. This article adheres to that concept. Exformation will be understood here as superfluous, irrelevant information, as a meaning that we do understand, but which does not become a piece of knowledge (it is not potentially knowledge-forming). A more detailed explanation will be given in due course.

Various significant authors in the field of informatics and information science distinguish between data and information, by understanding data as merely a potential piece of information, as interpretable facts, as the carrier of information, and they emphasize the role of the recipient or user of information, as well as the significance of information within the system and the process of decision-making, see e.g. [7], [8], [9]. Data will therefore be distinguished from information by defining the term data: For the purposes of this text, the term **data** (or datum in the singular) will be understood as a representation of reality, that is as something that represents or stands in for reality or its features (attributes that are significant for some purpose), the representation itself being meaningless. The value of data therefore lies in the potentiality of their future transformation (in the process of interpretation) into comprehensible information. It should also be mentioned that Checkland and Scholes [8] add the term capta (from Latin *capere* – to catch/capture), by which they refer to the data, or their subset, that were selected by a specific recipient (user) from the set of all available data. Checkland notes that the process of the transformation of data into capta is a common mental process which is so natural to us that we do not even notice it and we '*automatically*' work only with the subset of data that we have selected [16].

The distinction between data and information as it is understood here corresponds with the semiotic concept of information (semiotics is a general theory of sign), which distinguishes the syntactic, semantic and pragmatic aspect of (or demands on) information, which correspond to the three sub-disciplines of semiotics – syntax, semantics and pragmatics. The syntactical aspect of information concerns the form in which it is realized. The semantic dimension refers to the meaning of information (in connection with its interpretation therefore refers to the meaning of the interpreted data). The pragmatic aspect relates to its use, or the value of information for the recipient (pragmatics deals with the relation between a denotation and the interpreter).

Information in the semiotic sense is referred to as semantic information, which has a meaning and it fulfils three requirements that follow from the above. The first of these requirements is syntactic relevance, which means that the recipient of information has to be able to detect these data. The second of these demands is semantic relevance. The recipient has to know what the identified data mean (interpret their meaning). And finally, the third requirement is

pragmatic relevance: information has to have some value for the recipient (it must be applicable). Failure to comply with the last requirement may lead to a situation in which information, although it fulfils the requirements of syntactic and semantic relevance (the recipient understands, interprets), is in fact 'exformation' (see above) rather than information, due to its inapplicability for the interpreter. After receiving information, "the recipient is informed, which means that on the basis of perception and interpretation he or she transforms information… and thus possibly gives it new expression in a new formulation" [17].

The physicist Brillouin, using Heisenberg's uncertainty principle, formulated the relation between the small expenditure of energy needed for gaining information and the great energetic effect resulting from its application [18]. This is a so-called negentropic effect, which enables the growth of energy caused by acquiring information to be compensated by the use of energy sources related to the acquired information [18]. This leads to the problem of information value.

With the use of probability theory, Shannon's formula quantifies the value of various entities of a system, e.g. a sign. The more frequent this sign is, the lower is its information value. In market environment, the value of information can be determined in accordance with the approach of the Austrian school [12], [18], on the basis of the law of diminishing marginal utility or increasing marginal cost. It focuses on individual knowledge of market conditions from a subjective-utilitarian perspective on which the success of an individual's decision-making depends. This concept corresponds with the so-called quantitative concept of information. According to this concept, there exists for each decision-making process an optimal range of information in which the difference between the usefulness of information and the cost of acquiring it is at a maximum. The problem lies in determining the usefulness of information, which is – according to the Austrian school – perceived strictly subjectively [12]. Usefulness is difficult to measure, but it is possible to determine the basic factors which influence the extent (amount) of information needed for solving decision problems, which include e.g. the importance of a decision problem (decision), the reversibility of a decision, the required accuracy and detail of information, the availability of information, time pressure, available resources (for acquiring, processing and analysing information) or the knowledge of the decision-maker.

Going back to the concept of information, it will now be defined for the purposes of further analysis. During the process of interpretation, the individual ascribes a certain meaning to data, based on his or her individual knowledge. **Information**, then, is just this meaning, which is a 'mere' transitional phase between data and (pieces of) knowledge. Information is the result of 'comprehending', not of 'comprehension'. In order to fully understand the 'relativization' that has just been made, it will be necessary to show and define certain significant connections, especially the importance of knowledge.

Referred to here as knowledge is a process whose realization depends on the participation of many subjects that are not isolated from ambient conditions and that affect one another (e.g. as a result of cultural determination), with human individuality having a decisive role in the final knowledge-constituting (knowledge-forming) phase. The integration of the static (structure) and dynamic (process), concept of knowledge leads to a definition of the term knowledge; **knowledge** in its most general form is understood as interconnected structures of pieces of knowledge on the basis by which an individual understands the outside world in a certain way and which constantly change as a result of interaction with the outside world. It should be added that the individual considers this understanding to be very-similar and they find it reassuring.

The Figure 1 shows the cyclical relation of data, information and knowledge – for details, see [19]. Not only does it transcend the 'classical' linear view, it also illustrates the importance of constantly reshaped individual knowledge in the process of interpretation and in creating explicit models of reality (data). Moreover, considering the fact that data are the 'product' of individual activity and individual knowledge, they cannot be regarded as objective in the sense of the absence of subjective determination. It should be noted that data are a representation of reality, but this representation may not necessarily be objective (for this reason there is a question mark next to 'source' in the figure below, as this has to be considered).

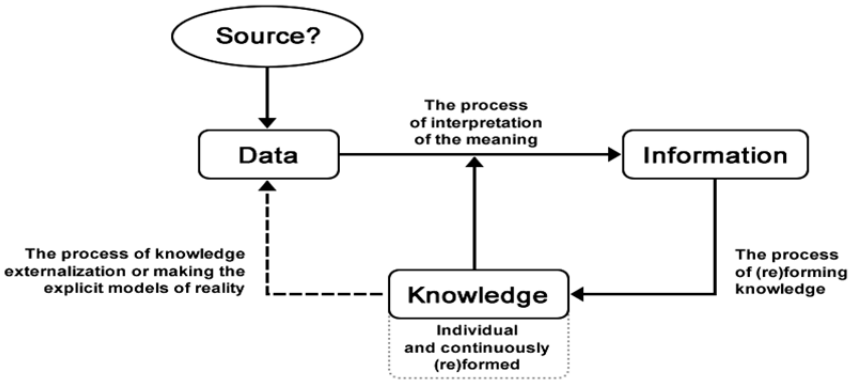

Figure 1. The cyclical relation – data, information, knowledge

It seems apt now, within this brief theoretical delineation, to mention the taxonomy of educational goals devised by the American educational psychologist Benjamin Bloom, which tends to be simplified as a classification of the six basic so-called 'cognitive aspects' that characterize the levels (phases) of acquiring (creating) knowledge: remembering (knowing facts, establishing pieces of knowledge), understanding, application, analysis, synthesis and evaluation. But the complete (or extended) Bloom's taxonomy (see Table 1) characterizes two additional areas: psycho-motoric and emotional aspects, which incorporate values and attitudes (a more detailed explanation can be found in the literature).

Table 1. Extended Bloom's taxonomy of educational goals [19]

Cognitive domain	**Affective domain**	**Psychomotor domain**
Remembering	Receives phenomena	Imitation
Understanding	*Responding to phenomena*	*Manipulation*
Application	*Values*	*Precision*
Analysis	*Organization*	*Articulation*
Synthesis	*Internalizing values*	*Naturalization*
Evaluation		

This need to be considered especially when discussing the question of comprehension and evaluation, which are in humans connected to emotions, or to be more precise, without them any 'comprehension' cannot be imagined. Emotions, as Lehrer [20] shows, greatly affect our decision-making. Important for this analysis is the fact that in practice, learning tends to be substituted for merely the first level of Bloom's taxonomy (remembering facts, acquisition, imitation), or can even do without it (see Table 1).

For any further consideration, it is important to make the distinction knowledge/a piece of knowledge (as hinted above). A piece of knowledge is different from knowledge in that it is only its fragment. Thus, based on the static concept of knowledge, which understands knowledge as a structure of interrelated pieces of knowledge, a piece of knowledge is one specific 'excerpt' from this structure. In accordance with the definition of knowledge, a **piece of knowledge** will be regarded in this paper, due to the absence of context and its fragmentary nature, as 'knowledge' that has no potential to make decision-making more effective and the value of which approaches zero (we know that we know something, but we do not really know what that is and thus we cannot use it) – hence the term **fragmentation of knowledge**. It describes information that only becomes knowledge when it is interconnected with other pieces of knowledge in the learning process (the first phase is therefore not sufficient, it has to be followed by other phases of the taxonomy), in which human thinking (a more profound mental activity) plays a pivotal role. The term **learning** will in this context be understood as a knowledge-forming process.

If information is understood as '*potential negentropy*' [18], which is not in contradiction with the interpretation in this article, it is information as an 'intermediate phase' that potentially decreases our ignorance. It is then an acceptable simplification to say that information is potential knowledge and thus knowledge itself is the negentropy, as the degree of organization which determines how 'much' we understand a given phenomenon (system). If an individual follows incorrect data or has incorrect knowledge, they interpret incorrect (e.g. inaccurate) information resulting in incorrect (inadequate, not corresponding to reality, etc.) knowledge. The **value of knowledge** thus determines the extent to which we are able to achieve such understanding that would enable us to make the right decisions, to be not only efficient in decision-making, but also purposeful (doing the right things).

It follows from the text that if we inquire about the **importance of knowledge**, we want to know about its role within the considered system. To simplify that, it is possible to say that the significance of knowledge concerns the role knowledge plays in such processes, i.e. 'what it does'. On the other hand the value of knowledge is about 'how it does that'. What, then, is the significance of knowledge? What role does knowledge play (generally)? Those questions will be answered in next sections.

Another term important for this interpretation is **system**. Here it is understood as a set of components that create, by their interaction, a new feature that characterizes the system. A system is also a '*way of viewing*' [21] the world, the considered phenomena, or a 'cognitive construct for assigning meaning to surprising facts' [22]. A systems view or approach means a view (approach) which, while using systems thinking (e.g. [7]) as a form of thinking that – unlike the 'conventional way of thinking' leads to considering all possible ways of finding a solution – accentuates the relations between the observed phenomena, and at the same time a question about the possibilities of knowing (the know ability of) a system in general, with the aim of making future decision-making more effective (in the sense of achieving correctness). There is a significant connection between the terms system and model, which is understood here as a 'purpose-made abstraction of reality' and whose connection to a system (per se) and a significance for the forming of our picture of reality (in connection with individual knowledge) is further explained from the perspective of the discussed topic.

What remains to be explained is the theoretical 'grounding' of the term 'informatization'. **Informatization** will be understood as the process of penetration within information and communication technologies (ICT) into various spheres of human activity and associated new possibilities of working with data or potential information. The term information society or (in a purely economic perspective) information economics was, for a that reason, established in the second half of the past century, in connection with the changes in employment towards the so-called information sector and with the increasing share of information services and products in GDP.

The process of informatization was significantly influenced by the internet phenomenon. Current questions and current research often focus on issues that are connected with it. In Gasset's words [23], thanks to modern technology we become better and better in '*defying space and time*' and the global spread of information technologies, and the availability of internet services leads, in this context, to a process that could be called 'virtualization of society'. The virtualization of society as a whole can be discussed in connection with the billions of users of these services and their massive interaction. A critical reflection in the context of the discussed topic follows in the relevant section below.

The analysis of selected relevant titles (publications) identified, among other things, the following significant conclusions are drown (results of the current state of knowledge):

- In the name of instrumentalization and commodification of education, we are, according to Liessmann [2], witnessing an aversion to understanding and thinking itself is being degraded.
- There is a tendency towards superficiality and the depth of the processing of information is decreasing [3].
- The 'shallow processing of information' is influenced by the media and the fact that they make access to information easier, as discussed e.g. by Carr [24], who aptly called his book *The Shallows.*
- Learning material is not 'penetrated', only skimmed over, as discussed by the logician and linguist Chomsky [5].
- There are studies which arrived at the conclusion that if students' performance in learning with the use of computers and without it is measured, learning with the use of computers has a negative impact at their performance [10].

3. Materials and Methods

The paper uses mainly the so called 'paired logical methods', such as abstraction/concretization, analysis/synthesis, induction/deduction. It is also necessary to emphasize the important role of critical reflection when using the methods of analysis and synthesis. Apart from the data gained by the study of the existing sources, the article also rests on data from the own research, which was carried out partly as a sample survey (as an explorative research) evaluated with the use of the tools of statistics (absolute and relative frequency, arithmetic mean, standard deviation), using a questionnaire as the selected method of data collection. This quantitative research is illustrative in nature and its results are discussed in the last two sections.

As regards the interpretation of the results, we used reflective analysis and interpretation, as well as a phenomenological approach, or phenomenological interpretation.

Relevant sources were critically analysed as part of the research. Given the character of the research and the nature of the topic, the bibliography includes international interdisciplinary sources. The exploration of the literature and the subsequent

analysis and synthesis of the sources became not only an important basis for the formulation of a theoretical draft, as shown above, but it was also one of the sources of results and arguments in the critical discussion.

Concerning the questionnaire survey, it is necessary to describe the sample and the process of data collection. All 342 respondents were at the time of the survey students of the B.A. programme Informatics or an informatics related M.A. programme (Information Systems and Technologies, Information Management, Knowledge and Web Technologies or Cognitive Informatics) at the University of Economics, Prague. In the total number of respondents there were 259 men (76%), 73 women (21%) and 10 respondents (3%) did not state their gender.

Given the illustrative nature of the research, it was not so important whether the sample would be statistically representative; the aim was rather to selects a specific sample of 'students of informatics', who are supposed to 'have managed' information technologies, which makes it possible to focus on their 'work with information' and to aim subsequent recommendations into the educational environment.

4. Results

The results of the questionnaire survey are as follows:

- Only 25% of the respondents admit that they prefer original sources to their interpretations.
- 20% of those questioned uses interpretations without being concerned about their validity.
- On a scale from 1 to 5 (1 being the best), only 18% of the respondents evaluated their ability to work with information as 1. 80% evaluated it as 2 or 3.
- (Self-) criticism in the evaluation (see the previous point) is surely appropriate. When the respondents were asked to identify the most important aspects of the credibility of information, only 54% (out of 338 valid answers) stated that congruence with other sources of information mattered to them, and mere 30% of the respondents rely on their own knowledge. When verifying the credibility of information, only a third of the respondents checks whether the author is a specific person. Finally, 5% of the respondent are not concerned about credibility at all.
- If a lecturer uses electronic presentations in his or her lectures, which lecturer then makes available as study material, then 20% of the questioned students prepare for the exam using only that presentation (340 out of 342 having answered the question in accordance with the assignment), stating that they learn points from the electronic presentation. As much as 62% of the respondents study other study materials as well (books, periodicals…), but they study it only casually (superficially). Only 18% (which is the smallest of the three groups) prepare for the exam by a thorough study or other materials than a PowerPoint presentation.
- 46% of the students who chose one of the answers to the question about their attitude towards buying a seminar paper of a qualification thesis (out of the total number of 340 respondents) stated that they would not have a paper written for money, but they were tolerant in the sense that it is everyone's own business. Only 36% of the respondents regard that as a fraud. 8%, on the other hand, have considered or even used that possibility (10 respondents from the total number).
- Only 18% of the respondents (62 out of 336 people who answered the question according to the instructions) consider philosophy to be a necessary subject. Economics is regarded as the most essential subject from the given options (by 87% of the respondents); mathematics could be dispensed with according to 30% of the respondents. In the case of mathematics there is the highest dispersion value, which shows that some respondents value mathematics greatly, while others see it as necessary, but do not assign to it any greater importance. The standard deviation for mathematics is 1.92, which is higher than 1.7 for economics, but, above all, greater than for law (1.21), marketing (1.4) and accountancy as well (1.32).

5. Conceptual Model

The model of importance of knowledge (Figure 2) summarizes the fundamental interpretation of the term knowledge that is presented in this article, including related terms, and it explains the importance of human knowledge in the process of getting to know a real object (system). Thus, it accentuates the problem connected with creating individual knowledge, or with acquiring pieces of knowledge and 'transforming' them into knowledge. The model is based on the above; it integrates the approaches of the quoted authors as well as concepts of the authors of this article. It is original in four basic attributes:

- It works with the term piece of knowledge, by which it presents as an 'internalized piece of information', and it makes the distinction piece of knowledge/knowledge.
- It defines information as a 'mere' transitional phase from 'real' data to a piece of knowledge (a

potential piece of knowledge, or potential knowledge).

- It seems that 'real activity' (behaviour, management) always follows from individual knowledge, and not from explicit models, which are also the 'products' of individual knowledge.
- At the same time, it shows the importance of knowledge in the problem of interpreting an interpretation.

The importance of knowledge then, according to the concept introduced here, lies in the fact that it makes it possible to 1) understand reality, 2) share the gained understanding with others (create explicit models), 3) make decisions about one's own actions.

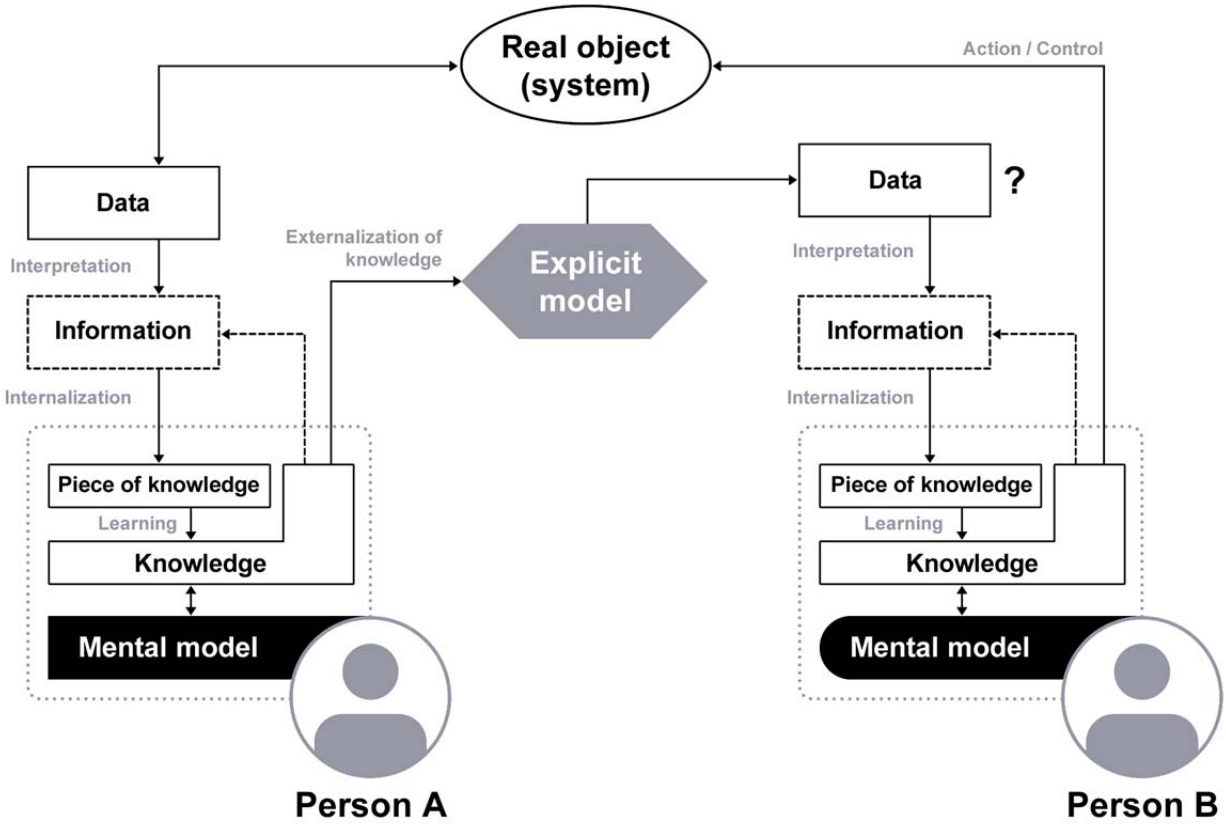

Figure 2. A model of the importance of knowledge

At this point it is necessary to briefly explain the formulated model. If we wish to purposefully influence an examined (controlled) system, such as any artefact, company or perhaps national economy, etc., or if it is in our interest to understand anything else, we create, on the basis of our individual knowledge, models of these systems (i.e. their purpose-made abstractions), which we call mental models. A real object (system) is therefore understood as a model of this object (system). The success of our individual decision-making or subsequent management (purposive and targeted interference with a real-life system) therefore depends on our knowledge and on the models we create on the basis of individual knowledge of those systems (whether we ignore relevant interactions between the individual elements, their data requirements, etc.); it thus depends on whether we have such knowledge that is sufficient for our decision-making and, to put it simply, useful.

Person A in the diagram above (see Figure 2) is getting to know a real-life object (system), say, in order to be able to write an article in which they explain to the readers how that object (system) works. Let it be supposed that they already had some knowledge of it and 'in their head' they have a mental model of the object (system). Different shape of the figures 'Real object' and 'Mental model' alert Person A to the fact that this model is only a selective abstraction and because of the limitations of Person A's cognitive abilities and other determinants it is not a one hundred percent correct idea of the real system (per se). Person A thus acquires some 'real' ('empirically registrable') data about the object. Since they have knowledge of the fact that the acquired data represent something (they understand them in some way), they interpret them as

information 'about something'. The broken outline of the rectangle called 'information' signifies that information is only some kind of 'transitional phase' from data to a piece of knowledge and then to knowledge, i.e. individual 'understanding' (comprehension) of a real object. Once a piece of information is internalized (i.e. it is not exformation, see above), it ceases to be information. Person A uses it to create a new piece of knowledge and (only later) re-forms his or her existing knowledge of the object by complementing it with this newly-acquired (in the process of learning) knowledge. The new 'understanding' can also be used for adjusting a person's mental model of the object (system). Person A then writes up his or her article (creates an explicit model of the system under consideration), i.e. externalizes (shares) their knowledge. This explanation shows that information is the result of comprehending (it is a meaning that is 'somehow represented', is 'about something' and 'for something' and its interpretation by the recipient is made possible by his or her knowledge) and a piece of knowledge is the result of comprehension (of the learning process), which can be subsequently shared (communicated).

Then there is Person B. They might understand the object in question even 'less' than Person A (or differently). Person B reads the article by Person A, who did not create an explicit model that would be completely identical with his or her own mental model, due to the necessary change that is a consequence of the externalization and formalization (at least unintended) of their knowledge. Person B interprets the data as information that is meaningful for them. Their knowledge as well as their mental model of the real-life object is different from those of Person A, because of their already different knowledge, and also because of the above-mentioned 'shift' during the externalization of Person A's knowledge. But it corresponds even less with the true nature of the real-life object (system per se). It is an interpretation of an interpretation. Individual knowledge will, however, determine Person B's actions in a specific real-life situation.

The practical consequences and implications of the above are part of a critical analysis (or its results, synthesis) and discussion in the following section of the text, but it can already be foreshadowed that the discussion will focus predominantly on the issue of fragmentation of knowledge as a consequence of superficial ('thoughtless') gaining of disjointed (mutually unconnected) pieces of knowledge, on the consequences of 'knowledge base' that is insufficient for the ability to interpret information, etc.

6. Critical Analysis and Discussion

The above-mentioned theoretical concept of the relation between a 'piece of knowledge' and knowledge, i.e. the distinction piece of knowledge/knowledge, is an important fundament for solving the established research question. Its practical implications will now be discussed. It seems fitting to quote Brouk [6] at this point, who writes that "only a shallow person can look at the contemplative man as at a man who wastes his time." Such economic utilitarianism, which puts usefulness (immediately expressible in terms of money) as the only measure of things and which is incapable of critical self-reflection – the so-called managerial approach to education – is regrettably an important philosophy of our time. It is in connection with this that the fragmentation of knowledge can occur, which is thus a consequence of a shallow ('thoughtless') acquirement of disjointed (mutually unconnected) pieces of knowledge. The insufficient knowledge base then has an adverse effect on an individual's ability to interpret information, attribute meanings to data, to understand them and to gain an understanding, i.e. to form adequate knowledge.

When talking about the present-day information and knowledge society, the society of knowledge, etc., it is interesting to remind ourselves of the ideas of some sociologists (e.g. [25]), who – at the turn of the 1960s and 1970s (on which it is possible to illustrate that sociology cannot predict future development) – predicted that the society at the turn of the millennium would be based on knowledge and it would be knowledge that would determine one's power and prestige, that in the post-industrial society, property would not be important in decision-making, that it would be knowledge (especially deep theoretical knowledge), because prestige and fame, according to what they say, was to shift from managers toward scientists and teachers. While in reality, we are currently witnessing something else, as evidenced here.

It should be noted that the consequences of the so-called 'knowledge explosion' not only for further development of science were already described by Wiener [26] in the early 1960s. In the early 1980s, the American forecaster Naisbitt [27] characterized ten basic developmental trends in the changing society. One of them was a shift from an industrialized society to an informatized society; he also pointed out the importance of network structures taking the place of hierarchical structures, the shift from decision-making based on linear thinking to deciding between a greater number of options, the phenomenon of decentralization, or an increased emphasis on self-help within 'interest' groups instead of reliance on the help of institutions. Above all,

Naisbitt [27] has thus pointed to the changing importance of information.

There seems no need to discuss the increasing interconnectedness and dependence of the processes under way on contemporary information and communication technologies. Petrusek [28] selects and introduces over a hundred terms used for the modern society, including such terms as childish, footman or narcissistic society. In a section dedicated to information society, he makes a reminder of the objection that Webster [29] – the critic of the concept of information society – made, warning that 'quantity' itself does not necessarily mean a change in the structure and fundamental characteristics of a society; a few years later, this seems almost anachronistic. Given the increasing volume of transmitted information, or data (data transmission), it is often declared that there is an awareness of their importance for the society as a whole, and it is likewise declared that there is an awareness of the importance of knowledge, which is considered to be the result of information (or more precisely data) saturation.

A systematic building-up of human capital should then logically lead to creating a society based on knowledge and to 'knowledge-based economy'. It could then be regarded as paradoxical that the problems we are facing as a consequence of informatization lie, as mentioned for instance by Banathy [30], exactly in the insufficient understanding of the term information (or knowledge).

It has to be mentioned at this point that time-saving technologies [23] lead, on the other hand, paradoxically to the fact that we have less and less time, as discussed by the Norwegian social anthropologist Eriksen [31], who describes what is according to him an acceleration typical for the information society. It concerns creating an image of a human subject in internet services (e.g. Pinterest or Facebook) and creating an alternative of one's own self (cyberspace). Individual internet services can thus be understood as distinctive worlds with their own rules and laws which together create the virtual environment in which a person's virtual being/self is gradually recorded.

This happens not only in one's personal social life, but also in professional life, in which work teams, for example, are created. The role of still modern phenomenon of social networks, the well-known representatives of which are named above, is well described by Spitzer [3]: "Many people today find it impossible to imagine their lives in a world without social networks such as Facebook or Google+. At a meeting, they sit in a café opposite each other, but instead of looking into each other's eyes, they both look into their own smartphone – apparently to be able to quickly tweet their friends about how great their date is." It is also clear from the studies that the use of social networks such as Facebook, which is connected with a lower number of real contacts, have to lead in children to an "increase in the size of the social areas of the brain and thus to a lower social competence" [3].

When trying to find the answer to the formulated research question, an important source was the **questionnaire survey** which was intentionally (given the goals) carried out on the given set of respondents. The vast majority of the questioned students give up, in the case of the 'PowerPoint' type of teaching, any deeper study; they settle for memorizing the points in presentations or they just superficially acquaint themselves with other study materials (i.e. with the absence of a deeper mental activity in which knowledge is not formed, only pieces of knowledge are internalized). A significant part of these students approaches relatively coldly the problem of buying university (seminar, qualification…) theses. Philosophy is considered a necessary subject only by a minimum of respondents, and also mathematics is a subject which a third of the questioned students of informatics could do without.

The questionnaire survey that has been conducted pointed out, that students often do not actually study, but are only – led by supposedly utilitarian interests, following an expected immediate benefit – trying to graduate. This shows a distinction between 'having' and 'being' – having an education (a diploma, certificate…) and being educated [1]. The practical application of information technology and the course of the educational process make this way, which aims rather at ignorance, significantly easier.

At the same time, it is necessary, particularly in certain disciplines, to connect theoretical conclusions with practice; specifically, students need to be shown how they can use them in their practice, not only directly, but also indirectly (by expanding their capacity for reasoning, etc.). The authors also observe, in that context, that studying should not be about learning specific tools, which are temporary in practice, but about explanation and learning principles. It can be pointed to the current situation in education, when students often do not think and do not actually study, because, as has been shown, technology and also the mode of teaching testing knowledge (often connected with the application of technology) may help them in that.

In the current situation, we are taking a risk that future generations will not only be incapable of criticism, (self-) reflection, perhaps even in the sense of totalitarian technological rationality, the context of which is illustrated by Marcuse [32], but they will not even be able to interpret the world (processes)

around them in context and thus form their own opinion.

7. Conclusion

In the attempt to find an answer to the research question (*Can informatization contribute to the fragmentation of individual knowledge and thus negatively affect its value?*), in the formulation of which the authors were inspired by existing theoretical concepts. The (above) text explained the fragmentation of individual knowledge and its importance for the value of knowledge. According to its conclusions, knowledge is negentropy, fragmentation decreases this negentropy and therefore the value of knowledge as well (the meaning of the knowledge cannot be adequately realized). The results of the questionnaire survey suggest that students contribute to fragmentation by their approach which is influenced by their use of ICT.

In this respect, it should be noted that the use of ICT in education cannot be understood only negatively. ICT as an ordinary technology of today's world is positively accepted and adopted by young generations of people (e.g. in the educational process [33], [34]). However, it is necessary to be critical of role and (mis)use of ICT and to be aware of the negative consequences presented not only in this article.

Although the article is aware of its limitations (the sample of respondents, the focus mainly on Czech environment, etc.), it is possible to answer, on the basis of the findings presented above, that informatization may contribute to the fragmentation of human knowledge and thus negatively affect its value.

The main recommendations on how to react to the (as a consequence of informatization) changed conditions aim mainly at the area of education; they can be summarized in the following five points:

- to focus education on the development of (critical and systems) thinking
- not to abandon the 'learning (teaching) of knowledge', with knowledge not being substituted for mere fragments, pieces of knowledge
- to use modern ICT to support (expand the possibilities of) classical education (e.g. to increase the interactivity or attractiveness of what is being taught), not as a means of degrading classical education
- to react to the above by choosing a suitable way of testing knowledge, which includes testing the ability to think (e.g. testing how students comprehend the context by discussing an essay or suitably formulated questions)
- to focus within 'information education' also on current problems connected with informatization and virtual environment (e.g. information ethics, etc.) and on the issue of working with information (the question of interpretation, learning, etc.)

The results of this article should, beside the practical applications of the presented recommendations, models and concepts (in the field of informatics or as part of innovation of the pedagogical process), serve as a foundation for a further study of this area and they could be used as the basis of further scientific research.

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