Sovereignty by Personalization of Information Search: A Collective Wisdom May Influence My Knowledge

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Abstract. With the experiment that we outline in this paper, we have had the ambition to pave the way for addressing the problem of *supporting, enhancing and measuring collective AND informal learning, in particular serendipity*. We want to support a new type of free navigation on Web resources (Documents, Topics, Events and Agents – human and artificial -) that is driven by the learner's current needs and the preferences of the community of trust chosen by the learner, not by external actors. The experiment exploits the ViewpointS Web Application (VWA) prototype, that restructures a private version of a subset of the Web according to personalized choices in order to determine *distances/proximities* among resources. The process allows to enable, empower and measure the *influence of members of the community of trust of the learner*, on the learner's choices when navigating in search of THE resources corresponding to THE immediate need, goal, strategy, wish. In the following, we will outline: 1. *the rationale of our efforts* and 2. the user's reactions during the phase of -formal and informal- learning the functions and use of the prototypical software environment VWA, i.e.: *a proof of concept for VWA*.

Keywords: Learning as a Side Effect of Interactions, Collaborative and Group Learning, Personalized and Adaptive Learning Environments, Recommender Systems for Learning.

1 Introduction

Since a number of years, we work on a model, an approach, a paradigm called ViewpointS [1-6]. Recently, we also developed a system, called VWA (ViewpointS Web Application) than embodies the principles of the ViewpointS paradigm.

After a preliminary study concerned with the collaborative construction of ontologies [7], we have decided that simpler principles may better serve the process of structuring Information in order to usefully retrieve it when knowledge is needed, in particular through interactions with peers.

We have assumed that the Web consists of four types of resources: Agents (human and artificial, i.e.: event-driven software programs), documents, topics and events. As examples: two authors may be more or less « professionally distant »; but also an author is more proximal to his/her own papers (documents) as to someone else's; to his/her topics of interest; a sub-topic is more proximal to its super-topic as two totally distinguished topics; similarly: a Conference - an event - is more proximal to its topics as to other ones. You may compute proximities / distances in various ways building a kind of « spatial, geographic representation » of the world, governed by distances in a graph.

In our approach, these distances are directly influenced by the community of trust, rather than by other "logical, algorithmic" rules, such as those adopted in numerous previous works typical of various kinds of recommender systems based on the Semantic Web [8-12]. This community of trust is what we consider the origin of collective wisdom, contributing to the personalization of the graph and thus the corpus of resources accessed by the user. We have basically adopted the recommendation [13] "*that the combination of visualization and recommendation techniques to empower users with actionable knowledge to become an active and responsible part-taker in the recommending process, instead of being the typical passive provider of just personal preferences and social connections"* is a necessary, even if perhaps not sufficient, condition for the personalization of informational processes. We have interpreted this vision as an encouraging mandate towards the integration of collective human and artificial intelligence. Further, we have also capitalized (see e.g.: [1,6]) from the [14] that "*new user-centric directions for evaluating new emerging aspects in recommender systems, such as serendipity of recommendations, are required*. "

For us, this approach may represent a disruptive change of paradigm in many relevant processes of construction and access to Information (and therefore Knowledge) including the most relevant side effect: human informal learning. It is for us a strong assumption that "proximity" is a property known to facilitate learning [15] under the condition that proximity of resources depends on the dynamic behavior of the community of trust chosen by the learner. We are at the same time aware that the challenge we have adopted years ago is not yet demonstrated.

We have started to experiment VWA with a small but significant number of users. In this experiment we may distinguish two aspects: the user's (or learner's) reactions to the "new tool" during an indispensable initial phase of training and the effects of the new tool concerning understanding, discovering, learning using the new tool: informal learning [16] and social learning in a knowledge domain. Social learning consists of a kind of collective intelligence, where "*collective intelligence suggests that in certain settings, a group is better able to solve difficult problems than an individual working alone*" (see, for instance [17] in the crucial domain of medicine, or – even more generally: [18]). Notice that informal learning, even if it has no explicit learning objective, requires anyhow to solve the difficult problem that one should finally learn.

While the generic effects of VWA on informal and collective learning are described in another paper [19], the learner's reactions to the new tool (components, functions and use) are shortly described in this contribution.

An instance of context that seems to us relevant is offered by the compilation of a state of the art on some new, cross disciplinary research domain (e.g.: in translational research): it is evident that each researcher has his/her own preferences for collaborative filtering of too many and differently useful items, and that the best advisors are the human members of the trusted community of peers that (s)he has chosen.

2. Three degrees of personalization supporting sovereignty

In this section we outline the applicability of our approach to the goal as stated in the title, leaving details of the architecture and the algorithms to other contributions that have been quoted in the introduction.

The ViewpointS model relies on two concepts: *resources* and *viewpoints.* The *resources* are 'Human Agents', 'Documents', 'Topics', and 'Events'. 'Topics' may be keywords or short expressions aimed at describing other resources. Each *viewpoint* is a connection between two *resources* established by a 'Human Agent' (or alternatively by an 'Artificial Agent'). Both *resources* and *viewpoints* can be either extracted from the Web, or directly created by Human Agents. The *viewpoints* can be of five types; in this experiment, we concentrate on the two most important types: 'factual' and 'subjective'. A factual *viewpoint* means that the semantics linking the two *resources* can be checked by others, e.g.: when a 'Human Agent' is the author of a 'Document' or when a 'Human Agent' participates to an 'Event'. A subjective *viewpoint* means that the link indicates an emotion, an opinion or a belief of the emitter of the viewpoint, e.g.: when a 'Human Agent' likes a 'Document' or believes a 'Document' is relevant with respect to a 'Topic'. The bipartite graph consisting of *resources* connected by *viewpoints* is called *Knowledge Graph* (KG).

Since this graph is too complex to be interpreted by humans, it is locally transformed in the neighborhood of a target *resource,* whenever a user is searching information, into a *Knowledge Map* (KM). This transformation is automatic and goes through the following process: i) the user chooses a *perspective* by choosing the respective strengths of the 'factual' versus the 'subjective' *viewpoints* (the rule may be more complex), ii) the *viewpoints* connecting the pairs of *resources* are valued and aggregated into 'synapses' reflecting proximities and iii) the labels indicating distances (inverse from the synapses strengths) appear on the KM edges between resources. The KG->KM transformation is dynamic: whenever a member of the community updates the KG, the various KMs computed for the other members are impacted.

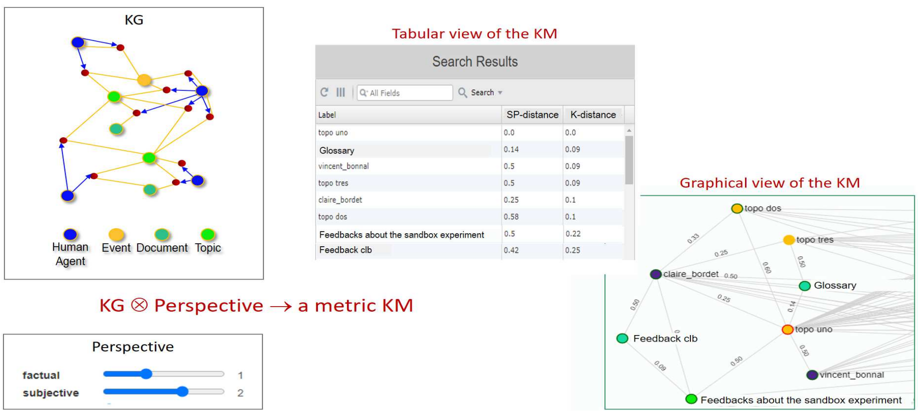

Fig. 1. The ViewpointS paradigm: 1. resources and viewpoints are stored in the KG (upper left), 2. a user chooses a perspective (down left) and searches for a resource (e.g.: "topo uno"), 3. a KM is computed in the neighborhood of "topo uno" and 4. this KM is displayed both in a table view (center) and in graphical view (right).

Fig.1 illustrates a KM computed around the neighborhood of the *resource* "topo uno". The distances labeling the edges of the KM in the right part are SP-distances (shortest path distances). In the central part, the tabular view recapitulates the SP-distances and K-distances (pseudo-distances taking into account the multiplicity of possible paths) between each resource and the target “topo uno”.

In the current experiment, the only Agents that produce resources and viewpoints are the Human Agents. This is a temporary simplification: artificial Agents may fruitfully produce many more useful resources and viewpoints in subsequent applications of VWA by activating softbots instructed to reason on Web resources. This aspect of our model enables us to declare that our approach is synergic and complementary with other ones available in the literature. The main differences with other models of access to Information (e.g.: Google) are:

i. the whole set of resources available on the Web is exploited in order to build *a subset of “relevant and trusted” resources*, organized in a bipartite graph called **Knowledge Graph (KG)**. Notice that Agents (Human or Artificial) are first class *resources* in ViewpointS, in the same way as Documents or Topics or Events. The process of selection of resources by qualified Agents offers *a first degree of personalization*;
ii. the User (or Learner) does not navigate on the KG, rather on a transformed graph, called **Knowledge Map (KM)** that is built *dynamically* -by means of a MapReduce transformation- according to a set of *preferences* (called a “perspective”) chosen by the Learner; viewpoints are weighted according to the preferences and then aggregated in binary links called “**synapses**” (adopting the metaphor of the brain [5]). The choice of preferences by Users offers *a second degree of personalization;*
iii. the Learner may share with a community of trust (a group) the same KG in such a way that *other Agents may contribute* (dynamically) with *new resources and/or new viewpoints, leading to the strengthening or weakening of synapses*. The **“collective behavior/wisdom”** offers *a third degree of personalization* which engages the collective rather than the individuals.

3 VWA(ViewpointS Web Application): the SandBox experiment

The process of learning “how to use” a new tool is not simple, for several reasons. The main problem is that if the tool is really new, it represents functionalities that are previously neither conceived nor acquired or mastered by the learner. Therefore, in order to expose our subjects to the “concepts” of the Information processes envisaged by the ViewpointS model, we designed and exploited a “SandBox” where we have invited our subjects to follow us in a first introduction on “concepts and essential procedures”.

In the “SandBox” tutorial experiment we have tried to teach Users-Learners to feed Data (e.g.: documents and topics) to VWA and to structure the Information necessary for VWA in order to answer a query (i.e.: to add viewpoints). The challenges were multiple: i) to keep Users within a *pro-active learning process*, ii) to introduce Users *progressively* to the various features and functionalities of the prototype while leaving them discovering it at their own pace, iii) to record and assess their *positive but also their negative* reactions to the learning environment, and particularly to verify their *acceptance and preferences* with respect to the main innovation of VWA.

Any User entering VWA immediately becomes a *resource* of the type ‘Human Agent” and, as such, will appear both in the tabular view and the graphical view of the KM as a blue node. All the learning resources are hosted by the KG “SandBox”. The three learning modules respectively named "topo uno", "topo dos" and "topo tres" are *resources* of type 'Event'; they aggregate *resources* of type 'Document': either videos or textual pedagogical documents. The three learning modules which introduce the ViewpointS paradigm are sketched hereafter:

Learning module n°1: discovering the environment. Users are firstly invited to listen to a 4'30" clip presenting the ViewpointS model, then to follow a clip teaching them how to connect themselves to a learning module;

Learning module n°2: the basics for proactivity. Users are taught how to create a new resource, how to connect two resources (a viewpoint), and finally how to connect a preview, i.e.: an image intended to give a hint before opening the resource;

Learning module n°3: understanding the underlying processes. Users are explained the importance of the "perspective", they go through the notions of "SP-distance" and "K-distance"; they learn how to emit reactive viewpoints and finally discover how "shortcut viewpoints" enhance serendipity [see, e.g.: 1,6].

The educational paths followed by the Users are hosted by the KG "SandBox" as well. As soon as a User has read (or listened to) the documents linked to a module, (s)he is asked to establish a connection, i.e. to emit a factual viewpoint, between him/her and the corresponding module. This appears in Fig.2 which is the view of the KG "SandBox" taken at the end of the process: the 36 participants (blue nodes) are connected to the three modules (orange nodes) which aggregate a Glossary and the 9 pedagogical documents (green nodes).

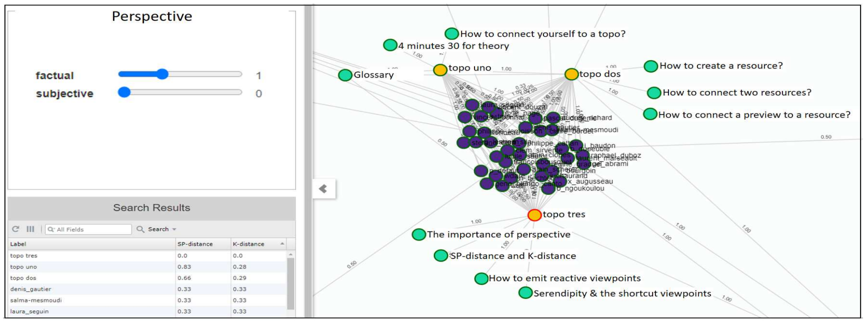

Fig. 2. A view on the three learning modules in the SandBox (resource type = "Event"; colour = orange), the 10 documents linked to them (resource type = "Numeric Document"; colour = green), and the 36 active Users (resource type = "Human Agent; colour = blue). The chosen perspective selects the factual connections and discards the subjective ones.

The pedagogy of the VWA SandBox intertwines therefore three learning modes: i) learning through documents, i.e.: "classical" knowledge acquisition through *resources*, ii) learning by doing, i.e.: creating resources and viewpoints and iii) participating to collective learning by reshaping the KMs browsed by the others.

Among the 55 initial volunteers, 36 people actually took the time to go through the three modules, as illustrated in Fig.2, despite the heavy time schedules and constraints of the autumn 2020. This could be interpreted as a relative success with respect to the challenge of keeping users within a *pro-active learning process.*

Fig.3 illustrates this proactivity; in the middle of the KM, we can see Users (Human Agents) subjectively connected to the 'Documents' they have appreciated. Note that the chosen perspective ('subjective' only) is orthogonal to the perspective of

Fig.2 ('factual' only) so that the map illustrates opinions about the content rather than participation in the modules.

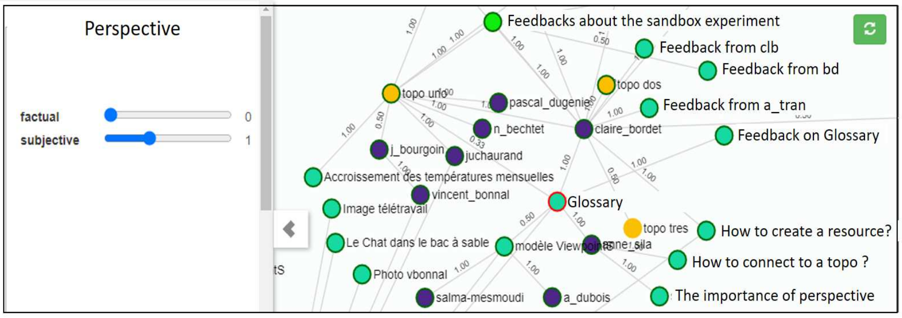

Fig. 3. A view illustrating the proactivity of the participants. The chosen perspective selects the subjective connections and discards the factual ones.

Assessment of the learning modules. Almost all participants acknowledged clarity of the pedagogical documents and easiness in the progression.

Assessment of the VWA environment. The participants had been firstly invited to contribute with free comments to a specific 'Topic' named "Feedbacks about the SandBox experiment". These comments pointed out several points concerning the environment: *a.* some users were disappointed not to be able to *suppress viewpoints* they had created; *b.* most users observed difficulties in exploiting the KM as soon as it became dense; *c.* several users asked for a "global view" of the whole KG, *c.* several users asked for special means to find back the resources created by themselves; *d.* one user asked for a special feature allowing the batch import of documents; *e.* one user asked for a shortcut grouping the actions of creating a new resource AND connecting it to an existing one; *f.* several users asked for a special feature facilitating contextualized comments on existing resources. In addition to those free comments, the participants were asked to rate from 1 (worst) to 5 (best) the two alternative views on the KM (tabular and graphical). This survey led to the following: tabular view: mean rating= 2,2 ; standard deviation = 0,80; graphical view: mean rating= 4,1 ; standard deviation = 0,53.

4 Conclusion

We make reference to [20] in order to qualify our SandBox experiment as a proof of concept of several rather radical changes in the collective construction and retrieval of knowledge. Referring to the goal of this paper indicated by its title, we believe to have proved several concepts: 1. Users exploit the graph representation with relative ease and increasing interest; 2. the proximity introduced by "synapses" in the KM is a useful means for aggregating resources and influencing the Users' navigation; 3. the three levels of personalization favor not only the trust of Users, but also their protection from external undesired influences (sovereignty); 4. the exploitation of collective wisdom by a trusted community allows to privilege shared values, interests, goals and knowledge; 5. learning the use of VWA in the SandBox has been a relative success, even if many suggested improvements of the current VWA platform will require to engage significant energy in the months to come.

References

1. Cerri, S.A., Lemoisson, P.: Tracing and enhancing serendipitous learning with ViewpointS. In: Frasson, C., Kostopoulos, G. (eds.) Brain Function Assessment in Learning. LNCS (LNAI), vol. 10512, pp. 36–47. Springer, Heidelberg (2017).
2. Lemoisson, P., Surroca, G., Jonquet, C. and Cerri, S.A.: ViewpointS: When Social Ranking Meets the Semantic Web. FLAIRS 17 Conf. Proc., Florida Artificial Intelligence Research Society Conference, North America (2017).
3. Lemoisson P., Rakotondrahaja C.M.H., Andriamialison A.S.P., Sankar H.A., Cerri S.A. VWA: ViewpointS Web Application to Assess Collective Knowledge Building. In: Nguyen N., Chbeir R., Exposito E., Aniorté P., Trawiński B. (eds) Computational Collective Intelligence. ICCCI 2019. Lecture Notes in Computer Science, vol 11683. Springer, Heidelberg, (2019).
4. Lemoisson, P., Surroca, G., Jonquet, C., Cerri, S.A.: ViewPointS: capturing formal data and informal contributions into an evolutionary knowledge graph. Int. J. Knowl. Learn. 12(2), 119–145 (2018).
5. Lemoisson P., Cerri S.A.: ViewpointS: A Collective Brain. In: Frasson C., Bamidis P., Vlamos P. (eds) Brain Function Assessment in Learning. BFAL 2020. Lecture Notes in Computer Science, vol 12462. Springer, Heidelberg (2020).
6. Cerri S.A., Lemoisson P.: Serendipitous Learning Fostered by Brain State Assessment and Collective Wisdom. In: Frasson C., Bamidis P., Vlamos P. (eds) Brain Function Assessment in Learning. BFAL 2020. Lecture Notes in Computer Science, vol 12462. Springer, Heidelberg (2020).
7. Lemoisson,P., Cerri, S.A.: Interactive Knowledge Construction in the Collaborative Building of an Encyclopedia. Applied Artificial Intelligence, Taylor & Francis, Special issue on Learning Grid Services, 19 (9-10), pp.933-966 (2005).
8. Alaa, R., Gawich, M., Fernández-Veiga, M. : Personalized Recommendation for Online Retail Applications Based on Ontology Evolution. ACM ICCTA 2020, April 14–16, Antalya, Turkey (2020).
9. Musto,C., Lops,P., deGemmis,M., Semeraro,G.: Context-aware graph-based recommendations exploiting Personalized PageRank, Knowledge-Based Systems, Volume 216 (2021).
10. Obeid, C., Lahoud, I., Khoury, H., Champin, P-A.: Ontology-based recommender system in higher education. The Web Conference Companion (WWW 2018), Lyon, France (2018).
11. Kotkov,D., Wang, S., Veijalainen,J. : A survey of serendipity in recommender systems. Knowledge-Based Systems, 111, C 180–192. (2016).
12. Pandey, G., Kotkov, D., Semenov, A. : Recommending Serendipitous Items using Transfer Learning. In CIKM '18 : Proceedings of the 27th ACM International Conference on Information and Knowledge Management, pp. 1771-1774, ACM Press (2018).
13. Verbert, K., Manouselis,N., Ochoa,X., Wolpers,M., Drachsler,H., Bosnic,I., Duval, E. : Context-Aware Recommender Systems for Learning: A Survey and Future Challenges. IEEE Transactions on Learning Technologies, 5 (4) 318-335 (2012).
14. Lops, P., de Gemmis, M., Semeraro, G. : Content-based Recommender Systems: State of the Art and Trends. In: Ricci F., Rokach L., Shapira B., Kantor P. (eds) Recommender Systems Handbook. Springer, Boston, MA (2011).
15. ZPD (Vygotsky): https://en.wikipedia.org/wiki/Zone_of_proximal_development , *last accessed 2021/03/18.*
16. Breuker, J., Cerri, S.A. : Learning as a Side Effect. In: Seel N.M. (eds) Encyclopedia of the Sciences of Learning. Springer, Boston, MA. (2012).
17. Tucker, JD., Day, S., Tang, W., Bayus B. : Crowdsourcing in medical research: concepts and applications. *PeerJ*. 2019;7:e6762. Published 2019 Apr 12. doi:10.7717/peerj.6762 (2019).

18. Muthukrishna M, Henrich J. : Innovation in the collective brain. Phil.Trans. R. Soc. B 371: 20150192 https://doi.org/10.1098/rstb.2015.0192 (2016)
19. Lemoisson, P., Cerri, S.A., Duzal, V., Dugenie, P., Tonneau, J.P.: Collective and Informal Learning in the ViewpointS interactive medium. Journal of Information (submitted, 2021).
20. Academic Careers for Experimental Computer Scientists and Engineers: to be downloaded from https://www.nap.edu/read/2236/chapter/1 *,last accessed 2021/03/18.*