Examining Intersubjectivity in Social Knowledge Artifacts

Research-in-Progress

Dmytro Babik
UNC - Greensboro
d_babik@uncg.edu

Ruoning Qian
UNC - Greensboro
r_qian@uncg.edu

Rahul Singh
UNC - Greensboro
rahul@uncg.edu

Eric W. Ford
UNC - Greensboro
ewford@uncg.edu

Abstract

Thanks to the modern ICT, social knowledge creation and dissemination has reached new frontiers of ease, accessibility and velocity. This raises questions of quality and validity of knowledge created in open online knowledge communities. Multiple models of knowledge evaluation in open online communities have been proposed but a general conceptual framework is still lacking. We develop a concept of Social Knowledge Artifact (SKA) and integrate it with the notion of intersubjectivity in the social systems of knowledge creation and refinement. Further, we outline a conceptual model of SKA evaluation that combines the constructs of the artifact attainment, artifact controversy, author self-assessment and reviewer bias. Our future research entails development and empirical testing of the research model and proposing recommendations for the design of information systems to support social knowledge creation and refinement.

Keywords

Intersubjectivity, knowledge community, knowledge artifact, peer review, bias, controversy.

Introduction

Modern Information and Communication Technologies (ICT) change the way knowledge is created, accessed and evaluated. Anyone with access to the internet can produce new or modify information and instantly share it with virtually the entire world. With the rapid emergence of online knowledge creation communities and the increasing openness of authorship, knowledge has changed from a closely guarded "walled garden" into an open "public commons". Open knowledge creation concepts are receiving increasing attention under such labels as "commons-based peer production" (Benkler 2006), "the wisdom of crowds" (Surowiecki 2004), and "open access movement" (Hardaway and Scamell 2012).

This shift raises interesting questions about the validity, accuracy and utility of socially created and socially evaluated knowledge, particularly the resolution of questions regarding facts, opinions, values and beliefs that may or may not be shared by the entire community. For example, a Wikipedia article reflecting current knowledge about a certain topic is co-created, co-evaluated and maintained by the self-organized community interested in knowledge on that particular topic (Dede 2008). Such knowledge creation and refinement is a social process of learning and interaction in a situated context that benefits both the authors and reviewers. The quality and usefulness of such representations of knowledge, however, varies. Therefore, a diligent user of information disseminated through the social media should be concerned about its source. Social knowledge creation and refinement inevitably relies on social processes of learning and evaluation.

Previous research has identified social evaluation as a potentially effective system for assessing and assuring the quality of co-created knowledge artifacts. While much research has focused on social construction of meaning and the benefits of technology-mediated contextualized learning and decision

making in web-based communities (Brown, Collins and Duguid, 1989; Dede, 2008; Miranda and Saunders, 2003), relatively little research attention has been directed towards the evaluation of social knowledge artifacts (SKA) that are widespread and becoming widely-accepted as sources of knowledge. We base our definition of knowledge artifact on the notion of cognitive artifacts - things that help us understand and perform tasks (Norman, 1991; Heersmink 2013; Salazar-Torres et al. 2008; McInerney 2002). Our interest in this paper is with SKAs -- representations of knowledge that are produced in social systems of interaction through social processes of learning and evaluation. A number of approaches to quality assessment of knowledge artifacts based on social evaluation have been proposed separately in education (Topping 1998, 2009), scholarly publishing (Hardaway and Scamell 2012; Mizzaro 2003), online encyclopedias (Cusinato et al. 2009), and online product reviews (Lauw et al. 2008). These contextualized models are special cases. A high-level conceptualization of the social evaluation domain is needed to gain a more general understanding of the problem and possible solutions.

The purpose of this research-in-progress paper is to outline a conceptual framework for social evaluation of SKAs as an intersubjective quality assessment mechanism, i.e. the mechanism that relies on shared understanding that emerges from subjective experiences and evaluations of multiple individuals (Schutz 1967).

We pose the following research questions that we intend to answer as we progress through this research: "*How can social evaluation be systematically used to facilitate creation and refinement of knowledge contributions? How can we model knowledge creation, evaluation and refinements as an intersubjective social process?*" The framework is meant to serve as a foundation for both academics and practitioners to research and design quality assessment and assurance mechanisms for SKA. Our study contributes to current understanding about social knowledge creation and evaluation process increasingly prevalent on the web and provides a systematic method to evaluate and improve the processual development of SKA in such communities. Eventually, these efforts should lead to a self-sustaining quality improvement paradigm for social knowledge creation and refinement. In particular, the new approach will reduce the amount and circulation time of inaccurate information.

Literature Review and Theoretical Foundations

In building our conceptual framework for social evaluation of knowledge artifacts, we draw from several research streams. In particular, the literature on social construction of knowledge is used to define the central concepts of our framework. To define the relationships among ontological elements, we studied social evaluation models in peer assessment in education (Topping 2009), peer reviews in scholarly publishing (Mizzaro 2003), quality assurance in open knowledge repositories (wikis, online product reviews, blogs, etc.) (Cusinato et al. 2009), and social evaluation (Lauw et al. 2008, Uebersax 1989). The commonalities in these models are combined with to the collective action model of institutional innovation (Hargrave and Van de Ven 2006) to build ontological and epistemological foundations of a unified conceptual framework for social evaluation of knowledge artifacts.

Knowledge Community, Knowledge Building, and Knowledge Artifacts

One important concept for understanding knowledge creation at the social level is *knowledge community*. It formed "when a relatively stable structure of meaning is established", and that "reproduces itself through continuous regeneration of meaning" (Tuomi 1999, p. 109). A knowledge community engages in activities of *knowledge building* that refers to social construction of knowledge by active sharing, discussion and negotiation among participants (Scardamalia and Bereiter 1994). Knowledge building works through the production and continual improvement of ideas valuable to the community. As a part of broader cultural efforts, communal knowledge is greater than the physical sum of individual contributions (Scardamalia and Bereiter 2003). Knowledge is commonly socially constructed through collaborative efforts toward shared objectives or through discourse evoked by differences in perspectives (Pea 1993).

For personal and subjective knowledge to be shared, it needs to be "expressed, described, or represented in some physical way, as a signal, text, or communication" (Buckland 1991, p. 2). Communicating knowledge is a process, but in order to capture and share knowledge conveniently, its representations are placed into a storage and retrieval system (ranging anywhere from tribal collective memory or papyrus to

a file on a hard drive or in the cloud). From the knowledge management perspective, if knowledge is articulated and presented in the symbolic form of words, graphics etc., it becomes explicit knowledge that can be shared, manipulated, and stored (Alavi and Leidner 2001; Nonaka and Von Krogh 2009). "Things" that represent knowledge are known as knowledge artifacts (Salazar-Torres et al. 2008; McInerney 2002). A knowledge artifact (KA) is "an object that conveys or holds usable representations of knowledge" (Holsapple and Joshi 2001, p. 46). From the knowledge building perspective, KA is a unit supporting the knowledge building processes. It is a carrier of knowledge that supports its sharing (Nonaka 1994) and as such it contributes to the evolution of the knowledge community by supporting its natural learning processes through social construction of meaning (Miranda and Saunders 2003). It is one of the basic components characterizing knowledge flows within an organization or a community (McInerney 2002).

KA as a unit of creation, exchange and storage of explicit knowledge is the key concept of our framework. It is widely used in the literature of knowledge management and artificial intelligence. We identify the following minimal set of KA attributes: author, purpose (intended use), content, medium/format, context clues (timestamp, physical or virtual location, title/keywords), and intended audience (Seiner 2001). Various types of KAs exist, but the ones of particular interest for this research are social knowledge artifacts (SKA) created through iterative and cyclical process of authorship and reviewership in which KAs are created, refined and published. Examples of such SKAs include academic papers, artwork, software, and intellectual contributions shared through social media (e.g., online forums, blogs, wikis) in any format (text, image, audio, video, etc.). Every SKA has an author (individual or collective) and a purpose (ranging from practical problem solving to academic inquiry to contemplation). For a SKA to be socially valuable, its purpose needs to be shared by a knowledge community. SKAs incorporate competencies and experiences of authors in different spheres, characterized by specific language (McInerney 2002) or framing (Hargrave and Van de Ven 2006). Moreover, in social knowledge creation, an author may act as a reviewer, and a reviewer may act as an author. In other words, the creation of a SKA is guided by the context which determines roles, relationships, expectations, and interpretations. In our research, we look at the phenomenon of intersubjectivity in social knowledge creation and refinement. Therefore, we are interested in how the performance of a contributor and the quality of SKA is determined through interactions of perceptions of authors and multiple users and reviewers, and whether self-perceptions match perceptions of others.

Assessment, Attainment, Objectivity, Subjectivity, and Intersubjectivity

To be socially valuable, a SKA needs to have certain *goodness* (or *efficacy)*. Users of a SKA (its "readership") use the SKA to achieve a purpose and discover its utility and quality. Utility signifies practical benefits of solving a problem regardless of its internal construction (Salazar-Torres et al. 2008). Quality, on the other hand, describes whether the KA is "well done" regardless of its practical benefits (McInerney 2002). For an academic paper, for example, quality can be interpreted as rigor, while utility connotes with relevance. A SKA has utility and is of quality when, as a whole, it contains *good knowledge* presented in a *good form*, which are accepted, desired or admired by the intended "readership". Utility and quality are users' latent perceptions but they can be captured through reflective construct of *attainment*, which, when measured on a scale, is an observable variable. In other words, utility and quality reveal themselves through assessment of a SKA by its "readership" making judgments about SKA's utility and quality (Mizzaro 2003).

Assessment is the process of judging, i.e. analyzing, evaluating and documenting goodness of a SKA as its attainment. The notion of assessment has been developed extensively in education literature. Formative assessment serves the purpose of helping the creator refine the artifact and improve competency through learning (Crooks 2001; Huhta 2008). Summative assessment expresses the attainment of the artifact or creator competency in some form of a measure, such as ranking, rating or a score (Shepard 2007; Topping 2009). Thus, the purpose of evaluations is to facilitate improvement of goodness of a SKA as a learning process (through feedback) and to inform the community about the qualities of the SKA based on the expertise, experiences and perspectives of multiple reviewers.

The main goal of assessing a SKA is to obtain an *unbiased* measure of its *attainment*, i.e. the evidence of its *goodness*. One way to assess a SKA's attainment is to compare it to a set of *objective* criteria of *goodness*. Objective assessment assumes a single *accurate* (*good*) answer or a task outcome. If such criteria are available, the *goodness* of the SKA is viewed as *correctness*, *accuracy,* or *validity. Objective*

and *unbiased* assessment can be accomplished only if the SKA results from a simple task. A simple task, by definition, has a straightforward desired outcome and a single solution scheme (Zigurs and Buckland 1998). Consequently, a non-conflicting set of *goodness* criteria can be applied to validate a simple-task SKA. Most SKAs, however, are very complex in nature because they emerge as outcomes of complex tasks. Complex tasks are characterized by various combinations of complexity attributes, such as outcome multiplicity, solution scheme multiplicity, conflicting interdependence, and solution scheme/outcome uncertainty (Campbell 1988). Academic papers, wiki contributions, Google knols, essays and artwork are but a few examples of complex task SKAs. The competencies of dealing with complex tasks require a combination of explicit and tacit knowledge (Nonaka and Von Krogh 2009). Criteria of *goodness* of such KAs are typically multiple, conflicting and often tacit. The same SKA grants different meaning to different individuals, depending on their backgrounds, positions and social context (Schutz 1967 as cited in Miranda and Saunders 2003). Since non-conflicting *goodness* criteria do not exist to validate a complex-task SKA, the reviewer's judgment about *goodness* of the SKA depends on her understanding of the content and the context. In other words, in such circumstances, only subjective criteria can be applied. Subjective assessment recognizes that *goodness* of the SKA depends on the positionality of the assessor. For example, a worldview statement is a complex-task KA resulting from personal experiences, internal struggles and external influences. Statements, such as "The God does not exist" or "Chocolate tastes better than strawberry", cannot be *validated* and, therefore, may be assessed as *accurate* (*good*) by an atheist (or a chocolate fan) or assessed as *inaccurate* (*not good*) by a believer (or a strawberry devotee).

The distinction between objective and subjective assessment, however, is also based on strong assumptions. In reality, there may not be such a thing as *objectivity* because all assessments are created with inherent biases with respect to relevant subject matter, content and context (JISC 2004). For complex-task SKAs, the assumption about validity of a single reviewer's judgment can be questioned because every expertise is limited, while complexity of tasks and corresponding SKAs is virtually unlimited (for example, Mochizuki's proof of the ABC conjecture, also known as Oesterlé–Masser conjecture, can be meaningfully assessed only by a few people (Hartnett 2012; Mochizuki 2012).

Subjectivity leads to a serious problem in evaluation of SKA's quality - the lack of consistency in assessment (Gray et al., 2006 as cited in Hardaway and Scamell 2012). No comprehensive solution to this problem exists, but a variety of models have been proposed in different settings. They are based on the belief that a collective assessment, or the wisdom of crowd, is more objective than a single person's subjective assessment (Surowiecki 2004). Scholarly publishing relies on social evaluation to assure quality of academic articles by delegating assessment and quality control to peer reviewers. The peer review mechanism is called to ensure a reasonable quality of papers, and the standard submission-review-publication process has been traditionally viewed as an adequate, although not ideal, solution (Mizzaro 2003). In education, multiple peer assessment has been also shown to be at least as reliable and valid as the expert assessment (Cho, Schunn and Wilson 2006; Falchikov and Goldfinch 2000; Topping 1998; 2005; 2009).

Traditional peer review process, however, presents two risks: (1) the reviewers' view of a paper is to accept while in retrospect the academic community's view would have been to reject and (2) the reviewers' view is to reject and the academic community's view is to accept (Straub 2008as cited in Hardaway and Scamell 2012). Thanks to the ease and velocity of communication through the web, new models of quality control of digital academic SKA based on social evaluation, have been proposed as an alternative, or at least a complement, to the traditional tightly controlled peer review process (Hardaway and Scamell 2012; Mizzaro 2003). Models of social evaluation have been also suggested for the domains of open knowledge building and consumer-created content in e-commence (Cusinato et al. 2009; Hu et al. 2007; Lauw et al. 2008). In the future, social evaluation may potentially be the only feasible approach to assess a large number of SKAs being created at an incredible speed.

The relationship between validity and reliability of social evaluation of SKAs is a fundamental question that has not been resolved (Uebersax 1989). These notions are interrelated rather than independent. Validity of collective judgment with respect to an external criterion is limited by interobserver reliability (Uebersax 1989). Therefore, inferences concerning evaluation validity can possibly be made from reliability data (Uebersax 1989). In the absence of *objective* criteria of *goodness*, the nature of validity and reliability lies in the *intersubjectivity* of evaluations. Intersubjectivity means the sharing of subjective states by two or more individuals and describes understanding that emerges from shared experiences

(Schutz 1967). Meaning derives from *intersubjective interpretation* by multiple persons, not simply from the cognition of a single individual (Miranda and Saunders 2003). Thus, intersubjectivity emphasizes that shared cognition and consensus is essential in the shaping of ideas and relations. Goodness of a complex-task SKA, therefore, can be derived as the aggregation of the SKA's attainment assessment by multiple reviewers.

Bias, Controversy and Self-assessment

Two problems exist with deriving validity from reliability. Firstly, a SKA may be so complex that applying a limited set of criteria produces a severe divergence of formative and summative assessments among different reviewers. In other words, the SKA has a certain degree of controversy. *Controversy* of an SKA can be defined as a higher degree of divergence of assessments among less biased reviewers (Lauw et al. 2008). Secondly, the competence of any given reviewer (assessor) is limited and focused. Therefore, her opinion with respect to the SKA may be *biased. Bias* of a reviewer is defined as a higher degree of deviation in the reviewer's assessments from other reviewers on a less controversial SKA (Lauw et al. 2008).

Lauw et al. (2008) identify two types of approaches to social evaluations of an artifact. In the naïve approach, bias and controversy are measured using standards statistical measures (average deviations). The weakness of this approach is that it ignores interdependency between bias and controversy. According to Lauw et al. (2008), determining the bias of a reviewer requires knowing the controversy of artifacts the reviewer evaluated and vice versa. Lauw et al. (2008) proposed a social evaluation approach based on the following propositions: (1) social evaluation is subjective, as reviewers and artifacts have varying bias and controversy, respectively; (2) bias and controversy are interdependent and cannot be estimated separately. Lauw et al.'s (2008) reinforcement-based model determined bias and controversy simultaneously, along with evidence – the degree of confidence with which bias and controversy have been estimated. The more artifacts the reviewer has evaluated, the higher the evidence of the reviewer's degree of bias. Similarly, assessment of an artifact by less biased reviewers produces more evidence of the artifact's degree of controversy. Lauw et al.'s (2008) notion of evidence echoes Mizzaro's (2003) notion of steadiness. Along with bias and controversy, attainment (the measure of goodness) is the key concept of social evaluation of KA. Mizzaro (2003) calls it a "paper score", whereas Lih (2004) calls it the "level of good standing".

In the evaluation of SKA, intersubjectivity is also manifested by miscalibration – the dissonance between peer reviewers' perceptions of the SKA goodness and the author's own perception. Self-assessment is a complex social activity influenced by many factors including the nature of the performance and competencies being assessed, clarity of assessment criteria, context, and affective conditions, such as self-efficacy, motivation, and perceptions of autonomy, competence, and relatedness. Recognizing one's own level of competency requires looking outward to the environment, particularly to the assessment of one's competencies and products by others, and using this feedback to inform one's self-assessments. In the context of SKA, self-assessment and self-reflection pay dual role: they should stimulate author's motivation and creativity to produce and refine new artifacts and yet they should guide the author to be responsive to external feedback and evaluations. Self-assessment and self-regulation are activities intrinsic to professional behavior and creative pursuits. Accurate self-assessment results in greater satisfaction with the accomplished results and stimulates aspiration to reach new goals. Yet, research suggests that accurate self-assessment is difficult to achieve. Studies in economic psychology indicate that subjects with lower competency (the "unskilled") tend to overestimate their abilities and performance (the "unskilled-and-unaware" problem), while subject with higher competency (the "skilled") typically underestimate their performance (Kruger and Dunning 1999; Ryvkin, Krajc and Ortmann 2012). Moreover, these biases are typically highly asymmetric because many more "unskilled" overestimate their outcomes that the skilled underestimate theirs. According to Kruger and Dunning (1999), the reason for this is that the unskilled lack the metacognitive ability to realize their incompetence and are, thus, afflicted by a "double curse": The expertise needed to evaluate performance in many complex domains is the same expertise necessary to produce good performance in the first place. Thus, the unskilled failing to reach high attainment are also unable to judge accurately just how incompetent their artifacts are. Furthermore, because of their imperfect expertise, the unskilled are simply not in a position to recognize the depths of their deficiencies (they are unaware). By the same token, if the unskilled are weak in

recognizing the attainment of their own artifacts and competencies, they may be biased in assessing other creators' artifacts.

In the following section, we integrate the concepts of attainment, controversy, bias and self-assessment into a framework of social evaluation of SKAs.

Conceptual Framework for Social Evaluation of Knowledge Artifacts

Based on our literature review, we propose a conceptual framework for social evaluation of SKAs. This framework includes the model of the unit of analysis and the model of the outcomes of social evaluation of KAs. The unit of analysis in this research is SKA which ensues from iterative interactions between the author (individual or group), who produced the artifact, and multiple reviewers, who contribute to the development of the artifact by providing feedback consisting of formative and summative assessment (Figure 1).

Figure 1. Unit of Analysis of SKA Evaluation
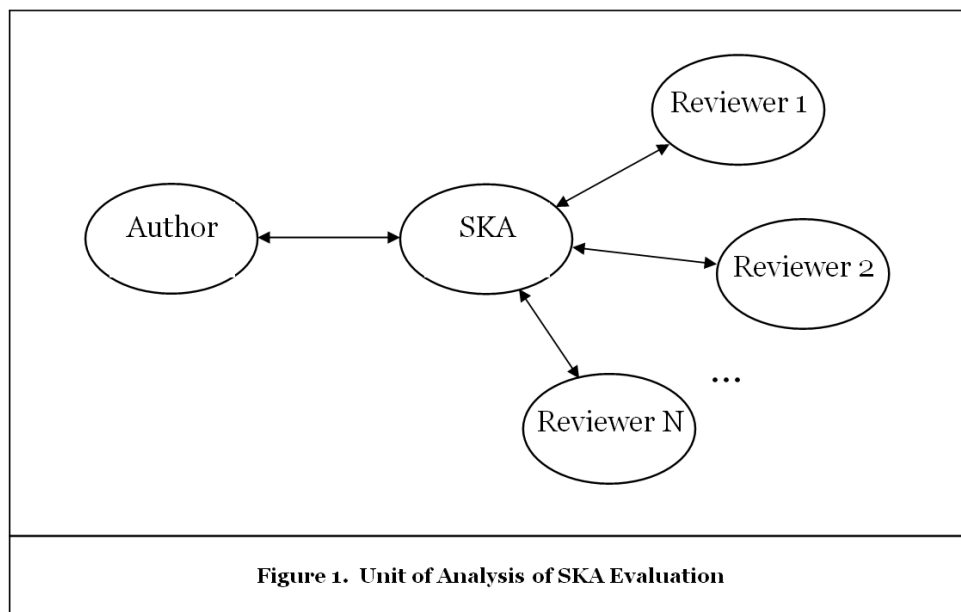
Moreover, in the social knowledge creation and refinement communities, every reviewer may contribute to the discourse as an author of another artifact, and every author may choose to act as a reviewer of other artifacts. We treat this interaction field of authorship-reviewership as a single unit, in which intersubjectivity may be measured as a combination of artifact attainment and controversy, author's self-assessment and individual reviewers' biases (Figure 2). Individual reviewers' summative assessments of a given SKA are aggregated to the attainment metric. In addition, by comparing individual attainment metrics given by multiple reviewers to a given SKA, we can derive the metric of SKA's controversy. Further, by comparing an individual reviewer's assessment of a given SKAs with other reviewers' assessments of the same SKA and aggregating the differences, we can produce the measure of bias for each reviewer. Finally, by comparing author's self-assessment with the aggregate peer assessment we can measure the level of miscalibration of author's self-perception about the SKA quality vis-a-vis audience's social perception. Evidently, attainment and controversy of the artifact, the reviewers' biases and author's self-assessment accuracy (the inverse of miscalibration) are interdependent concepts (Figure 2). Each of these concepts, when operationalized, has a measure of central tendency (aggregate or average), a measure of turbulence (variance), and a measure of confidence (accumulated evidence, or, essentially, a number of observations). Aggregated attainment and controversy indicate the *goodness* of the SKA and accumulated bias across multiple SKAs reveals efficacy of the reviewers.

Figure 2. Conceptual Model of SKA Evaluation
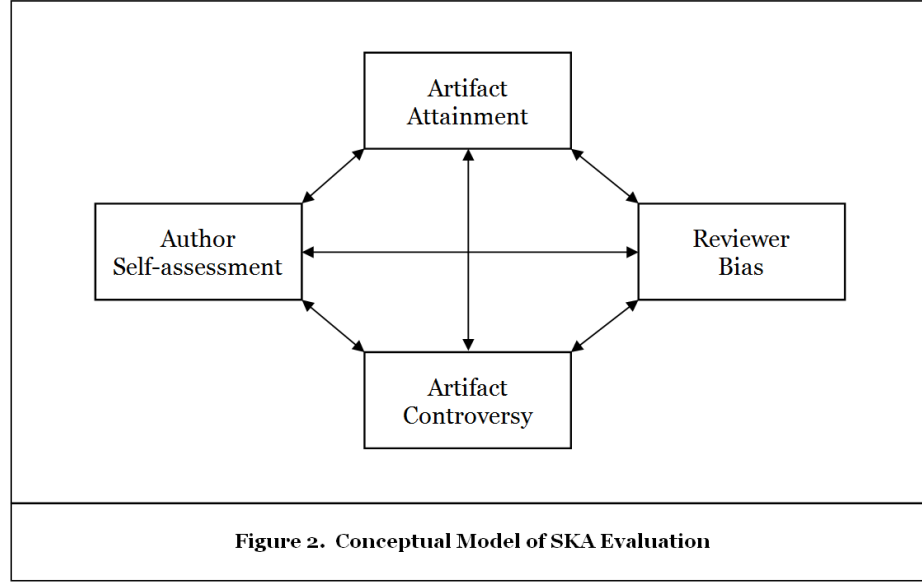
Knowledge, represented by SKAs, improves and refines over multiple interactions between authors and reviewers thanks to discourse and learning of participants. We describe the changes in the social system of knowledge community in the following set of propositions:

Proposition 1: Over the multiple iterations of author-reviewer interaction, attainment of SKAs produced by a particular author and determined by multiple reviewers increases.

Proposition 2: Over the multiple iterations of author-reviewer interaction, controversy of SKAs produced by a particular author and derived from assessments by multiple reviewers decreases.

Proposition 3: Over the multiple iterations of author-reviewer interaction, bias of the assessment produced by a particular reviewer and derived from its relationship with the assessments by other reviewers decreases.

Proposition 4: Over the multiple iterations of author-reviewer interaction, miscalibration(the difference between self-assessment of the artifacts by its author and attainment derived from assessment by multiple reviewers) decreases.

To validate these propositions, we plan to further enhance our framework by developing social process model of knowledge creation and refinement, as well as developing and testing hypotheses describing the relationships between the concepts of our framework.

Future Steps to Complete Research-in-Progress and Expected Contributions

An extensive literature review indicates a theoretical gap and an urgent practical need for research in the domain of social evaluation of knowledge artifacts. To fill the gap, we lay out theoretical foundations and outline the conceptual framework for studying evaluation and refinement of SKAs. In the further pursuit of this research, we aim to accomplish the following goals: (a) complete our framework with a process model of the social process of knowledge creation and refinement; (b) operationalize the model and develop hypotheses that relate SKA's attainment and controversy, author's self-assessment accuracy, reviewer bias and reliability; (c) build an information system artifact that will allow empirical testing of these hypotheses.

With this research, we expect to produce important contributions to the knowledge building, dissemination and management domain. Technological shifts in the way KAs are produced and shared lead to behavioral shifts in how individuals and collectives consume knowledge and contribute to it. Behaviors that were not possible in the pre-web 2.0 era are now becoming commonplace and require deep understanding of these new phenomena. Applying a generic conceptual model to social evaluations of SKAs in these distinct areas will gain valuable insights into how knowledge is built in various settings and what factors impact complex task competency development. Testing hypotheses of the future research models based on this conceptual framework, will establish grounds for designing more effective, efficient and vibrant knowledge building and management systems.

REFERENCES

Alavi, M., and Leidner, D. E. 2001. "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS quarterly* , pp. 107–136.

Benkler, Y. 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*, New Haven [Conn.]: Yale University Press.

Brown, J. S., Collins, A. and Duguid, P. 1989. "Situated Cognition and the Culture of Learning," *Educational Researcher*, (18:1).

Buckland, M. K. 1991. *Information and Information Systems*, New York: Greenwood Press.

Campbell, D. J. 1988. "Task Complexity: A Review and Analysis," *Academy of Management Review* (13:1), pp. 40–52.

Cho, K., Schunn, C. D., and Wilson, R. W. 2006. "Validity and Reliability of Scaffolded Peer Assessment of Writing From Instructor and Student Perspectives," *Journal of Educational Psychology*, (98:4), pp. 891–901, doi:10.1037/0022-0663.98.4.891.

Crooks, T. 2001. "The Validity of Formative Assessments," University of Leeds.

Cusinato, A., Della Mea, V., Di Salvatore, F., and Mizzaro, S. 2009. "QuWi: quality control in Wikipedia," in *Proceedings of the 3rd workshop on Information credibility on the web*, WICOW '09, New York, NY, USA, pp. 27–34.

Dede, C. 2008. "A Seismic Shift in Epistemology," *EDUCAUSE Review*, (43:3).

Falchikov, N., and Goldfinch, J. 2000. "Student Peer Assessment in Higher Education: A Meta-Analysis Comparing Peer and Teacher Marks," *Review of Educational Research* (70:3), pp. 287–322.

Gray, P., Lyytinen, K. J., Saunders, C. S., Watson, R. T., Willcocks, L., and Zwass, V. 2006. "How Shall We Manage Our Journals in the Future? A Discussion of Richard T. Watson's Proposals at ICIS 2004.," *Communications of AIS* (2006:18).

Hardaway, D. E., and Scamell, R. W. 2012. "Open Knowledge Creation: Bringing Transparency and Inclusiveness to the Peer Review Process," *MIS Quarterly* (36:2).

Hargrave, T. J., and Van de Ven, A. H. 2006. "A Collective Action Model of Institutional Innovation," *Academy of Management Review* (31:4), pp. 864–888.

Hartnett, K. 2012. "An ABC Proof Too Tough Even for Mathematicians," *BostonGlobe.com*.

Heersmink, R. 2013. "Embodied Tools, Cognitive Tools and Brain-Computer Interfaces," *Neuroethics*, (6:1).

Holsapple, C. W., and Joshi, K. D. 2001. "Organizational Knowledge Resources," *Decision Support Systems Decision Support Systems* (31:1), pp. 39–54.

Hu, M., Lim, E.-P., Sun, A., Lauw, H. W., and Vuong, B.-Q. 2007. "Measuring article quality in wikipedia: models and evaluation," in *Proceedings of the Sixteenth ACM Conference on Information and Knowledge Management*, CIKM '07, New York, NY, USA, pp. 243–252.

Huhta, A. 2008. "Diagnostic and Formative Assessment," in *The Handbook of Educational Linguistics.*, Blackwell Handbooks in Linguistics, B. Spolsky and F. M. Hult (eds.), Malden: Blackwell Publishing, pp. 469–482.

JISC. 2004. "Effective Use of Virtual Learning Environments (VLEs) - JISC InfoNet".

Kruger, J., and Dunning, D. 1999. "Unskilled and Unaware of it: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-assessments," Journal of Personality and Social Psychology, (77:6).

Lauw H.W, Lim E.-P, and Wang K. 2008. "Bias and Controversy in Evaluation Systems," *IEEE Trans Knowl Data Eng IEEE Transactions on Knowledge and Data Engineering* (20:11), pp. 1490–1504.

Lih, A. 2004. "Wikipedia as Participatory Journalism: Reliable Sources? Metrics for Evaluating Collaborative Media as a News Resource," *Nature*.

McInerney, C. 2002. "Knowledge Management and the Dynamic Nature of Knowledge," *Journal of the American Society for Information Science and Technology* (53:12), pp. 1009–1018.

Miranda, S. M., and Saunders, C. S. 2003. "The Social Construction of Meaning: An Alternative Perspective on Information Sharing," *Information systems research* (14:1), pp. 87–106.

Mizzaro, S. 2003. "Quality Control in Scholarly Publishing: A New Proposal," *Journal of the American Society for Information Science and Technology* (54:11), pp. 989–1005.

Mochizuki, S. 2012. "Inter-universal Teichmüller Theory I: Construction of Hodge Theaters," *preprint* .

Nonaka, I. 1994. "A Dynamic Theory of Organizational Knowledge Creation," *Organization science* (5:1), pp. 14–37.

Nonaka, I., and Von Krogh, G. 2009. "Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory," *Organization Science* (20:3), pp. 635–652.

Norman, K. L. 1991. "The Psychology of Menu Selection: Designing Cognitive Control at the Human/Computer Interface," *Intellect Books*.

Pea, R. D. 1993. "Seeing What We Build Together: Distributed Multimedia Learning Environments for Transformative Communications," *The Journal of the Learning Sciences* (3:3), pp. 285–299.

Ryvkin, D., Krajč, M., and Ortmann, A. 2012. Are the Unskilled Doomed to Remain Unaware?,"*Journal of Economic Psychology*, (33:5).

Salazar-Torres, G., Colombo, E., Da Silva, F. S. C., Noriega, C. A., and Bandini, S. 2008. "Design Issues for Knowledge Artifacts," *Knowledge-Based Systems* (21:8), pp. 856–867.

Scardamalia, M., and Bereiter, C. 1994. "Computer Support for Knowledge-Building Communities," *The Journal of the Learning Sciences* (3:3), pp. 265–283.

Scardamalia, M., and Bereiter, C. 2003. "Beyond Brainstorming: Sustained Creative Work with Ideas.," *Education Canada* (43:4), pp. 4–7, 44.

Schutz, A. 1967. *The Phenomenology of the Social World. Translated by George Walsh and Frederick Lehnert. With an introd. by George Walsh*, Northwestern University studies in phenomenology & existential philosophy, [Evanston, Ill.] Northwestern University Press, 1967.

Shepard, L. A. 2007. "Formative Assessment: Caveat Emptor," Erlbaum.

Straub, D. W. 2008. "Type II Reviewing Errors and the Search for Exciting Papers.," *MIS Quarterly* (32:2).

Surowiecki, J. 2004. *The Wisdom of Crowds: Why the Many are Smarter than the Few and How Collective Wisdom Shapes Business, Economies, Societies, and Nations*, New York: Doubleday.

Topping, K. J. 1998. "Peer Assessment Between Students in Colleges and Universities," *Review of Educational Research* (68:3), pp. 249 –276.

Topping, K. J. 2005. "Trends in Peer Learning," *Educational Psychology* (25:6), pp. 631–645.

Topping, K. J. 2009. "Peer Assessment," *Theory Pract. Theory into Practice* (48:1), pp. 20–27.

Tuomi, I. 1999. "Data is More Than Knowledge: Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory," in *HICSS-32. Proceedings of the 32nd Annual Hawaii International Conference on System Sciences, 1999*, p. 12–pp.

Uebersax, J. S., and Rand Corporation. 1989. *Validity Inferences from Interobserver Agreement*, Santa Monica, CA: Rand.

Zigurs, I., and Buckland, B. K. 1998. "A Theory of Task/Technology Fit and Group Support Systems Effectiveness," *MIS Quarterly* (22:3), pp. 313–334.