Translating New Knowledge from Technology Based Research Projects:

An End-of-Grant Intervention Evaluation Study[1]

Part I: Rationale and Methods

Vathsala I. Stone[2]

Abstract:

Obtaining societal benefits as impact from research that is sponsored through public funding has been a growing concern in recent years. This has led to Knowledge Translation (KT) as an emerging new field centered on promoting research impact through effective delivery of new knowledge, which underscores the urgency of evaluating research impact. This paper will address a more complicated issue – that of generating and evaluating impact from projects involving both research and development activities. This position paper is focused on translating new knowledge generated by technology based research and development projects. It will present a KT intervention study currently under implementation and evaluation at a federally funded center on knowledge translation for technology transfer at the University at Buffalo. It will present the proposed intervention strategy with its rationale; describe the intervention implementation and evaluation procedures, as well highlight quality features of the intervention evaluation.

Introduction

Knowledge Translation (CIHR, 2004, 2005; IDRC, 2007; Sudsawad, 2007) is an emergent field developing from a concern with research utilization (Weiss, 1979) and focused on effective communication of newly generated knowledge for enhanced use by relevant stakeholders. The desired goal is achieving societal impact through evidence based practice and policy making, an issue that has received increased attention of social scientists over the last century. It has been discussed under varying terminology including *knowledge utilization,*

[1] Paper presented at the Annual Meeting of American Evaluation Association, November, 2010

[2] Co-Principal Investigator, Center on Knowledge Translation for Technology Transfer (KT4TT), University at Buffalo, NY. vstone@buffalo.edu

knowledge transfer, knowledge dissemination, and knowledge exchange (International Development Research Centre, 2007). It is currently addressed as an issue of *knowledge translation* (KT) by several fields of research application, health care being in the forefront.

There is some debate over the need for scholars to be concerned about translating their findings which may be generated as contributions to the knowledge base rather than designed for application by others. The terms of Mode 1 and Mode 2 research attempt to distinguish between such basic and applied research intentions (Gibbons, et al, 1994; Nowotny et al, 2001, 2003).

The issue is less debatable for public funding invested in projects with the expressed intent of generating beneficial impacts for society. Such research and development (R&D) projects are increasingly held accountable for their performance and results (GPRA, 1993). This includes R&D projects that generate technology based knowledge where outcomes are expected in the form of products and services in the marketplace for the benefit of the end user. KT in this context implies communicating knowledge specifically for technology transfer (TT) outcomes, leading to benefits for the end user. It involves disseminating knowledge beyond the researcher community, enabling the use of knowledge by all relevant stakeholders, manufacturer being an essential stakeholder.

In all cases of KT, the basic concern is about impacting the ultimate beneficiaries i.e., the intended end users of knowledge (K). The challenge, however, is about devising effective KT strategies, i.e., the best way to communicate the generated K to potential users and to ensure it is used. Among other things, it involves delivering K to the users in forms that are not only accessible and usable, but also that make sense in the context of its application. In this sense, interventions to study what is involved in translating a given piece of K and what works for the relevant stakeholders that apply and use the K is important.

This paper describes a Knowledge Translation (KT) Intervention study currently underway at the Knowledge Translation for Technology Transfer (KT4TT) Center located at the University at Buffalo and funded by the National Institute on Disability and Rehabilitation Research (NIDRR). The center is focused on applying technology-based K to a validated societal need to benefit the quality of life of target audiences with disabilities via devices and services. This center is in its third year of funding from the National Institute on Disability and Rehabilitation Research (NIDRR). The research study on KT intervention addresses an important goal of the center, which calls for developing best practice models for KT focused on technology transfer (TT).

Context of the Study

An important mission of NIDRR is to improve the quality of life of persons with disabilities by funding research projects that focus on technology for access and function. NIDRR's technology grantees include national Rehabilitation Engineering Research Centers (RERCs) and Small Business and Industry Research (SBIR) projects. The broader context for research by these technology grantees involves R&D that implies technology transfer as an expected outcome. From the agency's accountability perspective (GPRA, 1993), these outcomes are key measures of impact from NIDRR funded research. The problem is one of KT for TT, where the K producers are NIDRR's technology grantees and the K beneficiaries are persons with disabilities. We consider six types of stakeholders that could use the K: 1. Manufacturers (product developers) who transform conceptual research findings into proof-of-concept prototypes, devices and services; 2. Clinicians, who prescribe and fit the devices and services to consumers with disabilities; 3. Brokers (such as college disability services), who facilitate the use of devices by consumers; 4. Policymakers, who regulate the use of the devices and services;

5. Consumers with disabilities; and 6. Other researchers that advance the work of the original research project.

The KT4TT Center was recently established to research and develop best practice models of KT for TT. The target audiences for these best practices are NIDRR's technology grantees, the K producers. A goal of the KT Intervention study is to develop and evaluate what works as a best practice model for KT4TT in this context.

Purpose of the Study

Focusing on a selected NIDRR grantee innovation (new knowledge), the intervention study conceptualizes a KT intervention strategy and evaluates its effect on the use of the new knowledge by the six types of stakeholders mentioned earlier. The center proposes to replicate the study in three areas of assistive technology, the current study being the first one addressing Augmentative and Alternative Communication (AAC) technology for persons with severe speech disabilities.

Guiding Concepts

The conceptualization of the current intervention study on grantee innovations in the AAC technology area draws upon two leading models related to KT at the present time - the Canadian Institute for Health Research (CIHR)'s conceptual framework as a general guide for KT (Sudsawad, 2007) and the related Knowledge-to-Action (KTA) model proposed by Graham et al (2006) as an implementation guide for this KT intervention. These models are summarized below. The KTA model in particular provides a basis for the development and testing of KT intervention strategies, especially when the focus of translation is an "end-of-grant" research output, as is the case with our current intervention study on AAC technology. However, as evolving models themselves, both the CIHR and the KTA models pose limitations to the

development of a full range of best practice models that consider: (a) intervening at various points in the lifecycle of a grant; and (b) the specific context of KT4TT. These limitations and alternative positions of the KT4TT center to guide our future studies are presented later in the discussion section.

The Canadian Institute for Health Research (CIHR) view of Knowledge Translation (KT):

Fig. 1 presents a framework that describes KT according to CIHR (2009). It inserts several KT opportunities in the Research cycle, which is shown as a flow of K from researcher out to global K and then back to the researcher as feedback to improve future research. Note that, in this view, the reference for KT is the research (R) process, K being the findings or outputs from R projects. On the one hand, it recognizes the researcher as the contributor to "global K through publications. On the other hand, it considers the "return" or feedback to the researcher after this K is placed in the context (contextualized) of those who apply it and generate impact that will influence future research. As the model views K mainly as a research output, accommodating R&D projects in this framework is not so straightforward. In particular, the model omits explication of the contextualization-application-impact chain, which includes important steps that shed light on the TT outcomes involved in technology-based research. Arguing for a need for this explication, the KT4TT Center has proposed an expanded framework, the Need-to-Knowledge Model (Lane and Flagg, 2010; Flagg and Lockett, 2010), for accommodating the KT for TT interventions, which is further addressed in the discussion section. Note also that the CIHR model views a KT intervention as an "end-of-grant" activity or an "integrated" activity, implying interventions after a grant is funded, but not before the start of the research activity. However, as a general guide to KT, the CIHR framework is applicable to the current study on AAC, which is focused on end-of-grant KT.

The Knowledge-to-Action (KTA) model for implementing KT:

Fig.2 shows the Knowledge-to-Action (KTA) model by Graham et al (2006) at CIHR which offers an operational guide to implementing KT within the CIHR framework. Its two key components are the Knowledge Creation funnel at the center and the Knowledge-to-Action cycle surrounding the funnel in a clockwise flow of action steps. The funnel generates the "knowledge", seen as the output from synthesis of multiple studies of inquiry. This is then taken to action by the outer circle steps which include: identify the problem of the user, select the K that is relevant as a solution; adapt the K, assess barriers to its use; tailor the intervention to the user; monitor use of K; evaluate outcome (use) and sustain use. The KTA model lends a basis for conceptualizing, implementing and evaluating a KT strategy, particularly for an end-of-grant output. While applying it for the current study on AAC technology, some procedural adaptations and expansions are necessary (See Fig. 2a). For example, "tailoring the intervention" needs further explication in terms of specific details. Note also, the end-of-grant focus in the KTA cycle. It starts with the K output as the "solution" and looks for the "problem" it can solve. Relevance is seen as matching solution to problem. This may have further implications for the way in which it can be applied to design implementation protocols for a full range of interventions related to for KT for TT. While this will be discussed later, the KTA model is valid as a basis for implementation protocols for the current intervention study on AAC. In fact, successful replication of the protocols in other technology areas as planned by KT4TT center will validate the KTA model for the end-of-grant KT context.

Knowledge Use:

The context for defining the "knowledge use" and "knowledge user" of the knowledge for this study is KT4TT. As mentioned earlier, KT4TT which implies translating knowledge

(KT) from technology based research. It aims for societal impact through technology transfer (TT) outcomes. Researchers funded for technology based R&D, such as the NIDRR's technology grantees, are producers of such K. As Lane et al (2008) have argued, a complete view of KT for TT goes beyond the research process, to encompass Development and Production processes that generate tangible proof-of-concept prototypes and market ready devices and services. Industry stakeholders (manufacturers) are involved along the way. Consumers of the products and services are the ultimate users of this transformed K while other stakeholders including clinicians, brokers, and policymakers are involved in facilitating such use by the consumers. Researchers other than the producers of the original K may also use the K for advancing it further. Taken together, all these stakeholders constitute six types of K users.

In defining K use as an effect of a KT intervention, the study considers the three possible types of use suggested by Estabrooks (1999), and cited by Sudsawad (2007). According to this view, *Instrumental use* refers to a concrete application of K, where the K is transformed into usable, material forms, such as a decision protocol, a tool, a working prototype, a device, or the like. *Conceptual* use refers to change in one's thinking, but not necessarily one's action. The K in this case just informs and enlightens the decision-maker. *Symbolic use* implies a strategic use of K, as a political tool to legitimize a view (advocacy) or a practice. In the intervention study, K use is measured as an effect of the intervention, covering all three types of use in an instrument of Awareness, Interest and Use. However, the primary focus of items is instrumental use, but additional open ended items might capture the other two types of use in the analysis. This is consistent with Sudsawad's review of related studies and the suggestion that it may be better to pre-determine the specific use for the K users in question so appropriate strategy may be devised for successful K use.

The K use in the study is referred to as Use of New Knowledge. The instrument is a web based survey on Awareness, Interest and Use of New Knowledge, and based on the concept of Levels of Use proposed by Halls et al (2006) in the context of measuring use of an innovative curriculum under the Concerns Based Assessment Model (CBAM). The Halls et al scale addresses behavioral aspect of use and does not focus on other aspects such as attitudinal, motivational or affective. The authors did not report the psychometric properties but Sudsawad (2007) considers the scale "*one of the most comprehensive in measuring use and could conceivably be quite sensitive in detecting small increments of progress in knowledge use. Particularly the scale would be useful in evaluating steps taken toward implementation even when the full implementation has not yet occurred"* (P. 27). However, it bears clarifying that while the new knowledge use survey does use the concept of levels and categories within levels, it differs from the original scale both in defining these levels and categories as well as in survey structure and measurement method.

Method

As mentioned earlier, the objective of the current Intervention Study is to conceptualize an appropriate KT strategy for a given new K in the AAC field. The intended beneficiaries for *what works* as an effective and feasible strategy are NIDRR and its technology grantees (K producers).

The focus of the study is *End-of-Grant Knowledge*, in other words, a selected output from a completed grantee project in AAC. The approach is to (a) select an innovation from a past RERC grant, (b) create an intervention strategy and corresponding tools for "translating" the innovative findings, and then (c) use the KTA model as a protocol guide for implementing the intervention and evaluating effects on K use by the six types of K users mentioned earlier. All are

stakeholders of AAC technology; Consumers in this case are persons with complex communication needs. The KTA model is an appropriate guide for intervention implementations related to end-of-grant outputs. Thus, replication of this intervention study in other technology areas will also validate the KTA model.

Creating the KT Intervention:

The initial steps of the Action Cycle in the KTA model (Fig. 2) call for matching the selected K with a relevant user problem, then "tailor" the K to the user, based on barriers to its use. We achieve this through the following steps, as shown in Fig. 2a.

Create Grantee Innovation Profiles (GIPs): From a pool of invited (nominated by the grantees) innovative studies in AAC, an innovation is selected through a review panel judgment. First, profiles are drawn of the innovation's characteristics with reference to their Novelty and Feasibility, as well as their Utility from the viewpoint of the intended users, and the innovations graded. Next, an innovative study is randomly selected from the group of "Grade A" studies.

Create Knowledge Value Maps (KVM) of organizations of use affiliation: While it is reasonable to expect the merit (rigor) of evidence in an end-of-grant output, its relevance (worth) to the user cannot be assumed. It is important to assess the specific context, interests and values of each type of stakeholder so the selected innovation can be "contextualized" to their needs and preferences. The study achieves this through interviewing the organizations of affiliation of each type of user and "mapping" the knowledge value (Rogers, 2006) of their memberships. For example, the American Technology and Industry association (ATIA) is interviewed for mapping manufacturer values (expectations) regarding new knowledge, using a value mapping questionnaire. Thus, six KVMs are drawn related to the organizations of the six K user types mentioned earlier.

Create Intervention Tools: Based on the GIP for the selected grantee output and the KVMs of the six different user types, a set of Contextualized packages (CKPs) and corresponding Webinar (training) modules for follow up are prepared. Importantly, the grantee is involved in this process, in keeping with the *propriety* standard (Joint Committee, 1994) of evaluation. This measure also ensures the credibility of the study vis-à-vis other NIDRR grantees in terms of utility and feasibility for their own contexts. Technical Assistance plans are made for those user participants who advance through the CKP and the webinar. As will be described later, the three tools represent a "multimodal" channel of delivery of the new knowledge, a recommended practice in KT literature (Sudsawad, 2007). During the implementation, the three tools are presented sequentially to the participant, and are optional. The intent is to assess their interest in the New Knowledge, in addition to gains in awareness and use, between pretest and post tests.

Implementing and Evaluating the KT Intervention:

Data Collection Design: The KTA steps specific to implementing the "tailored" intervention to K users, monitoring "use" and evaluating "outcomes", imply K use as the effect or outcome to be measured, but leave the research design open. The study follows a Randomized Control Trial (RCT) design, as shown in Fig. 3 for applying the intervention and measuring the effects. In addition, follow up data from participants will be collected for in-depth probing about the why and how of the K use, as well as feedback about the intervention itself.

As shown in fig. 3, the intention is to evaluate T_1 (the proposed KT strategy) comparing it with T_2 (the more passive, traditional way of knowledge dissemination and utilization - KDU) as well as with C, a control group who receive no communication about the New Knowledge. K use levels will be measured on these three groups once in the beginning, next at 4 months after

the intervention and again, 4 months later. The duration of the intervention is 8 months. Note that the figure represents the design for each of the 6 types of K user participants in the study. The following are the hypotheses to be tested.

Hypotheses:

1. The treatment innovation users who were provided with CKP intervention followed by web-cast and tech-assistance will reach more advanced stage of K use than the other groups and the treatment innovation users who were provided with the innovation information through KDU will reach more advanced stage of K use than the control group.

2. There will be differences in stage of K use among six types of users for treatment innovation.

3. The individuals who reach more advanced stage of K use have demographic and K use process characteristics different from the individuals who do not reach advanced stages.

Sample: Considering statistical requirements for the study, fifteen participants will be sampled for each cell in the design, amounting to a total of 45 per each K user type and an overall total of 270 participants. The sample size was determined by power analysis based on the study by Miller and Spilker (2003). In their study the difference between the control group who did not receive any information and those who received intervention on initiating action was d=1.03 and the difference between the control group and those who had a simple intervention was d=.96. In order to achieve 80% of power at $\alpha_1 = .05$, with large effect size, each group requires 13 participants. Assuming an attrition rate of 15% due to the novelty and relatively light demands of this study, it was decided to include 15 participants in each group.

The participants are recruited through the organizations of their affiliation. For example Clinicians/Practitioners are recruited through the American Speech and Hearing Association ASHA), and manufacturers through American Technology and Industry Association (ATIA).

Duration of the study: 8 months – 4 months between pretest and first post test and 4 months between the two post tests.

Measure: Awareness, Interest and Use of the New Knowledge are measured as an indicator of effectiveness of the intervention. As mentioned earlier, there are three different types of use possible in this case, i.e., conceptual, instrumental and symbolic (Estabrooks, 1999; Sudsawad, 2007). The study primarily focuses on measuring instrumental use. The other two types of use are likely detected in the open ended responses of the participants, and will be addressed in the analysis. As said earlier, this is consistent with KT literature (Sudsawad, 2007) which suggests pre-determining specific use for given K users as a good lead to devising an appropriate strategy for successful K use.

Instrument: As described earlier, a web based survey with items structured within a framework of Levels by Categories is used in the study to measure the participant's level of Awareness, Interest and Use of the New Knowledge presented in the survey. Summary information about the selected grantee study and the findings constitute the "New Knowledge". The survey is based on the concept of Levels of Use in earlier work by Halls et al (2006) and as pointed out earlier, has marked differences from the Halls et al Scale in structure and method of application and measuring. Fig. 4 presents the framework for the survey used in the study. Content validation of items by experts in KT and TT as well as pilot testing of the survey draft versions with representative K users are part of the psychometric evaluation of the instrument.

Additionally, an independent psychometric study of the survey is currently under way by a graduate student researcher at the University at Buffalo.

Current Status

The implementation of the first intervention study on AAC described above started in July 2009. Baseline data has been collected, and the intervention is in progress. All participants are expected to complete the final post test by July 2011. Meanwhile, replication studies are in planning for two other assistive technology application areas (i.e., wheeled mobility & consumer products).

Discussion

This paper presented the rationale and method for a KT intervention study currently under way at the KT4TT Center to implement and evaluate a KT strategy addressing new knowledge generated by technology based R&D projects. As first of a series of studies to be replicated, this study focused on past R&D in the area of AAC conducted by NIDRR's technology grantees. The proposed KT strategy is based on contextualization of K and its multimodal delivery (Sudsawad, 2007) to K users; and the approach to implement and evaluate the effect on the users considers an end-of-grant K. The CIHR framework and the KTA implementation were used for the conceptualization and implementation of the intervention.

In concluding, we raise two issues to be addressed. The first one relates to evaluation quality, a growing concern as evaluation continues to develop as a distinct transdisciplinary (Scriven, 2003) field. Scriven terms evaluation of evaluation as meta-evaluation (Stufflebeam, 2001, p.59), while the program evaluation standards of *utility, feasibility, accuracy and propriety* (Joint Committee, 1994) have laid the foundation for meta-evaluation. How do we evaluation professionals practice meta-evaluation, ensuring appropriate balance between standards in the

evaluations we conduct? Second, KT is an emergent and fast developing field, within which KT4TT is pioneering in terms of a theory. In developing KT4TT interventions, it is important to ground them in appropriate frameworks that accommodate all the variables involved. The CIHR and KTA models offer a solid start but we need a broader frame work within which to conceptualize KT4TT interventions and investigate *what works*.

Evaluation Quality: Intervention studies often tend to address the issue of quality based on process rigor (USDE, 2003), as research is central to their method. However, these studies are evaluative in purpose and addressing rigor responds mainly to the *accuracy* standard of evaluation quality. To be complete, the quality judgment of intervention studies must consider their utility, feasibility and propriety in conducting them. In developing effective KT strategies (best practice models), the current intervention study is mindful of the quality of the evaluation processes on two levels.

First, the KT intervention study uses a sound research methodology combining a randomized control research design with follow up, explanatory data from participants. This addresses the issue of *merit* of the method, and responds to the standard of *accuracy* of evaluations. As for the other three Joint Committee (1994) standards of *utility, feasibility, and propriety*, the study addresses them as follows. In conceptualizing the KT strategy we always consider the grantee point of view, with a question: Is this what we expect the grantee to do as part of KT? Is this step feasible? This ensures both *utility* of the strategy to the grantees and its *feasibility* in their context. Also by combining the RCT with in depth follow-up of the participants, we bring relevance (worth) to the data we provide to the grantees. *Propriety* is of concern when we involve the grantee researcher in the process as we create "contextualized" packages of a selected grantee study.

Second, in conceptualizing the KT strategy, our primary consideration is the relevance of the selected grantee innovation to the K user. The "end of grant" KTA model assumes relevance of the K (research output) to some user problem and proceeds to identify it at the start of the cycle. In the study, we ensure relevance to the K user by interacting with the organization of affiliation of the user - for example, American Technology and Industry Association (ATIA) for manufacturer users - and by describing the interests and values of its membership related to research use, through Knowledge Value Mapping (Rogers, 2000). This is the basis for the creation of the Contextualized Knowledge Packages, which are tailored to each type of K user in language, format and content.

An expanded framework for KT4TT: Earlier in this paper we pointed out that the CIHR and the KTA models are centered on the research process and on increasing stakeholder use of outputs from research studies, in their treatment of KT. This orientation poses limitations for applying the models to technology-oriented research and development projects which intend to result in commercial outcomes and societal impacts. First, the CIHR framework omits explication of the contextualization-application-impact chain, which includes important steps that shed light on the TT outcomes involved in technology-based research. Consequently, the KT4TT Center has proposed an expanded framework, the Need-to-Knowledge (NtK) Model (Lane and Flagg, 2010; Flagg and Lockett, 2010), for accommodating the KT for TT interventions. This is an expansion on the CIHR model integrating product development management (Kahn et al, 2005) concepts, and provides a more complete basis for KT4TT interventions, where KT4TT is viewed as a process-complex including Research (R), Development (D) and Production (P). This view opens up the D and P processes and sheds light on the existence of knowledge in three states (Lane and Flagg, 2010), and the importance of

ensuring the use of all three states by stakeholders, for beneficial impacts to occur. Importantly, a case is made for "need based" research that should start with a problem and an envisioned solution, if indeed the K is to be transformed into a technology-based device or service with beneficial impacts for society. At the same time, it duly recognizes the importance of relevance (worth) of the K to be generated alongside the rigor (merit) of the evidence ensured by the R process. From this perspective, the NtK Model starts before the research begins – eliminating the presumption of research activity, and instead including research methods as an option for generating new K along with the methods of development and production, as appropriate. Thus, the NtK Model can be viewed as a "prior-to-grant" perspective, where the focus is on applying the knowledge creation methods most appropriate for achieving the intended technology-based solution to the validated societal problem. The Center is contemplating interventions to explore the integrated and prior-to-grant perspectives in the near future, using the NtK model as framework for both.

Acknowledgement:

The author acknowledges support of the KT4TT Center which is funded by the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education, under grant number H133E030025. The opinions contained in this paper are those of the grantee and do not necessarily reflect those of the U.S. Department of Education.

References:

1. CIHR. *About knowledge translation.* Retrieved October 25, 2009, from http://www.cihr-irsc.gc.ca/e/29418.html
2. Center on Knowledge Translation for Technology Transfer (KT4TT). *The Need to Knowledge Model.* http://kt4tt.buffalo.edu/knowledgebase/model.php

3. Estabrooks, C.A. (1999). The conceptual structure of research utilization. *Research in Nursing and Health, 22,* 203-216.
4. Flagg, J.L. and Lockett, M. (2009).The Need to Knowledge Model: A roadmap to Successful Outputs for NIDRR grantees. *Focus: Technical Brief* no. 28, SEDL/NCDDR.
5. Gibbons M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994). *The new production of knowledge: the dynamics of science and research in contemporary societies.* London: Sage
6. Graham, I.D., Logan, J., Harrison, M.B., Straus, S.E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in translation: time for a map? *The Journal of Continuing Education in the Health Professions, 26*(1), 13-24.
7. Graham, I.D., & Tetroe, J. (2007). Whither knowledge translation: An international agenda. *Nursing Research, 56*(4), S86-88.
8. Hall, G.E., Dirksen, D.J., and George, A.A. (2006). Measuring Implementation in Schools: Levels of Use. Austin, TX: Southwest Educational Development Laboratory (SEDL).
9. International Development Research Centre (2007). *Knowledge Translation*: *Basic Theories, Approaches and Applications*. Retrieved, from http://www.idrc.ca/en/ev-125826-201-1-DO_TOPIC.html, last accessed 18 August 2010.
10. Joint Committee on Standards for Educational Evaluation (1994). *The Program Evaluation Standards* (2nd ed.). Thousand Oaks, CA: Sage Publications.
11. Kahn, K B, Castellion, G and Griffin, A (2005). (Eds.) *The PDMA Handbook of New Product*. Hoboken, NJ: John Wiley & Sons, Inc.

12. Lane, J.P., Stone, V.I., Bauer, S. M., Leahy, J.A., and Tomita, M.R. (2008). Center on Knowledge Translation for Technology Transfer. Proposal submitted to National Institute for Disability and Rehabilitation Research (NIDRR)'s Disability and Rehabilitation Research (DRRP) Program (84.133A-7).
13. Lane, J.P. & Flagg, J.L. (2010). *Translating three states of knowledge: Discovery, invention & innovation.* Implementation Science. http://www.implementationscience.com/content/5/1/9
14. Lomas, J (1993). Diffusion, dissemination and implementation. Who should do what? Annals of the New York Academy of Science. 703, 226-235.
15. Miller E.T. and Spilker, J. (2003). Readiness to Change and Brief Educational Interventions: Successful Strategies to Reduce Stroke Risk. *Journal of Neuroscience Nursing*, Volume 35, Number 4.
16. Nowotny, H., Scott, P., & Gibbons, M. (2001). Re-thinking science knowledge and the public in an age of uncertainty. Oxford, Cambridge, UK : Polity Press. 278p. ISBN 0745626076
17. Nowotny, H., Scott, P., & Gibbons, M. (2003). Introduction: 'Mode 2' Revisited: The new production of knowledge. *Minerva , 41*, 179-194
18. Rogers, J.D. (2000). Theoretical consideration of collaboration in scientific research. In J.S. Hauger and C.McEnaney (Eds.), Strategies for competitiveness in Academic Research (Chapter 6).
19. Scriven, M 1991. *Evaluation Thesaurus* (4th ed.). Newbury Park, CA: Sage.
20. Stufflebeam, D L (2001). Evaluation Models. *New Directions for Evaluation, #89*; San Francisco: Jossey-Bass.

21. Sudsawad, P (2007). *Knowledge Translation: Introduction to Models, Strategies, and Measures.* Austin: Southwest Educational Development Laboratory, National Center for the Dissemination of Disability Research. (p.4; 21-22)

22. USDE. Scientifically Based Evaluation Methods. Notice of proposed priority. FR Doc 03-27699. Federal Register: November 4, 2003 (Volume 68, Number 213). [Notices] [Page 62445-62447] From the Federal Register Online via GPO Access [wais.access.gpo.gov] [DOCID:fr04no03-38]

23. U.S. Office of Budget and Management (OMB). Government Performance Results Act of 1993. Retrieved Nov. 2, 2010 from http://www.whitehouse.gov/omb/mgmt-gpra/gplaw2m.

24. Weiss, C H (1979). The Many Meanings of Research Utilization. *Public Administration Review*, **39**(5): 426-431.

25. Wholey, J. S., Hatry H.P., and Newcomer, K E (eds.) (2004). *Handbook of Practical Program Evaluation,* San Francisco: Jossey-Bass.

Fig. 1. The CIHR framework as a general guide for KT (CIHR, 2009)

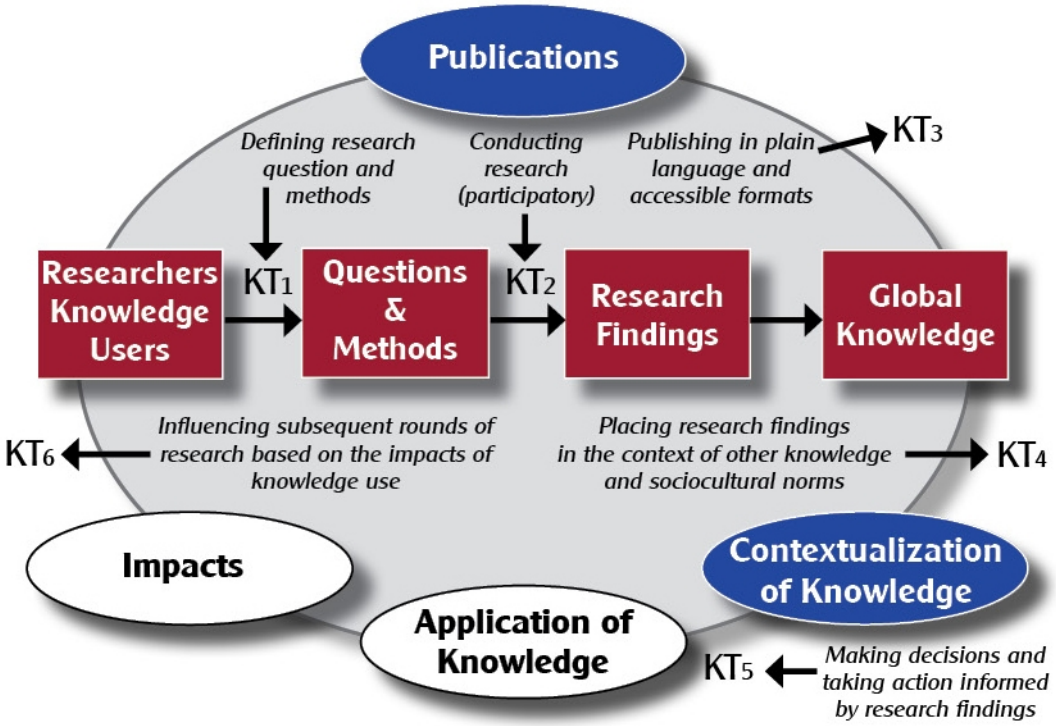

Fig. 2. Knowledge–to-Action Model (Graham et al, 2006)

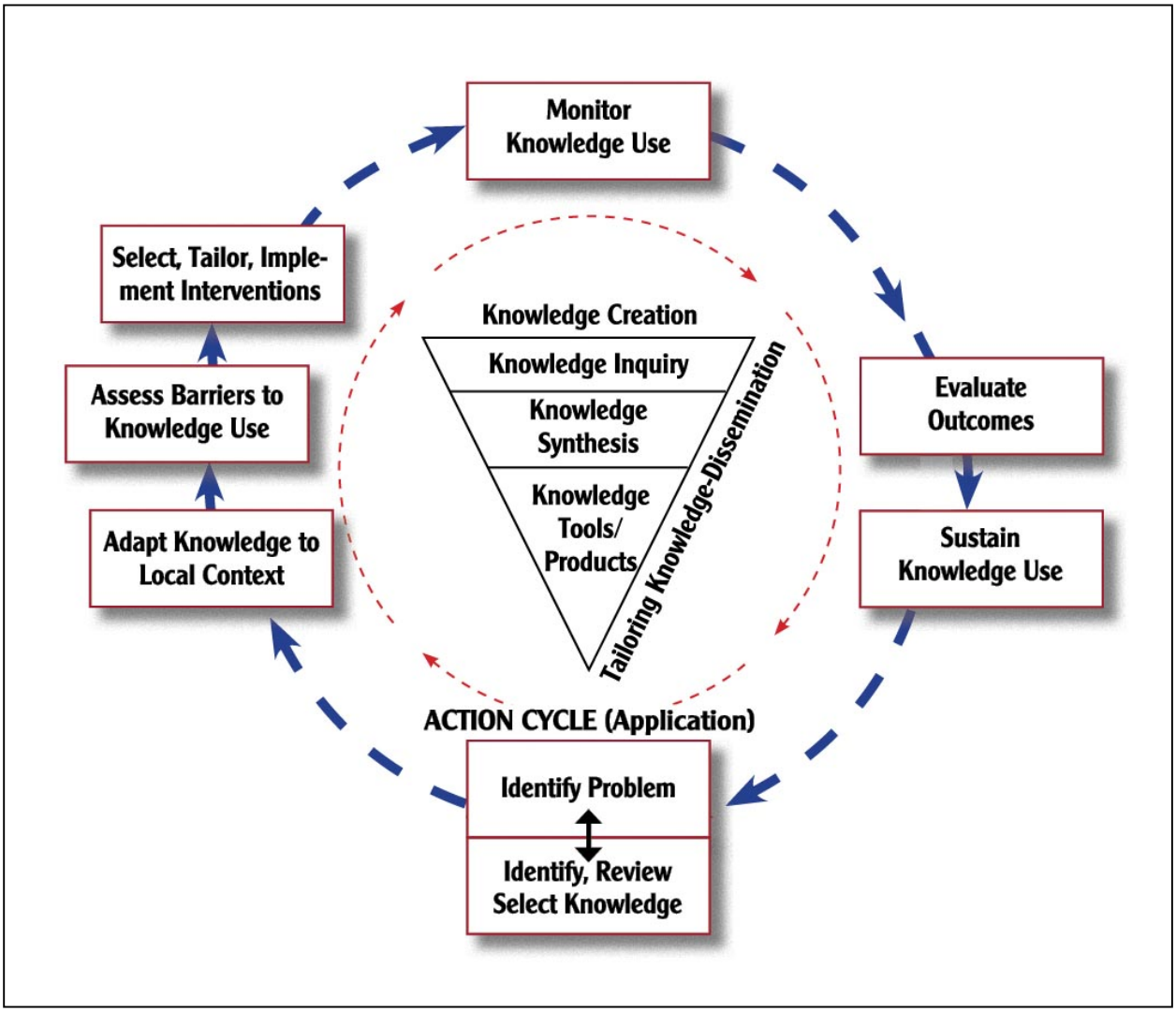

Fig. 2a.Implementing the AAC KT Intervention Study

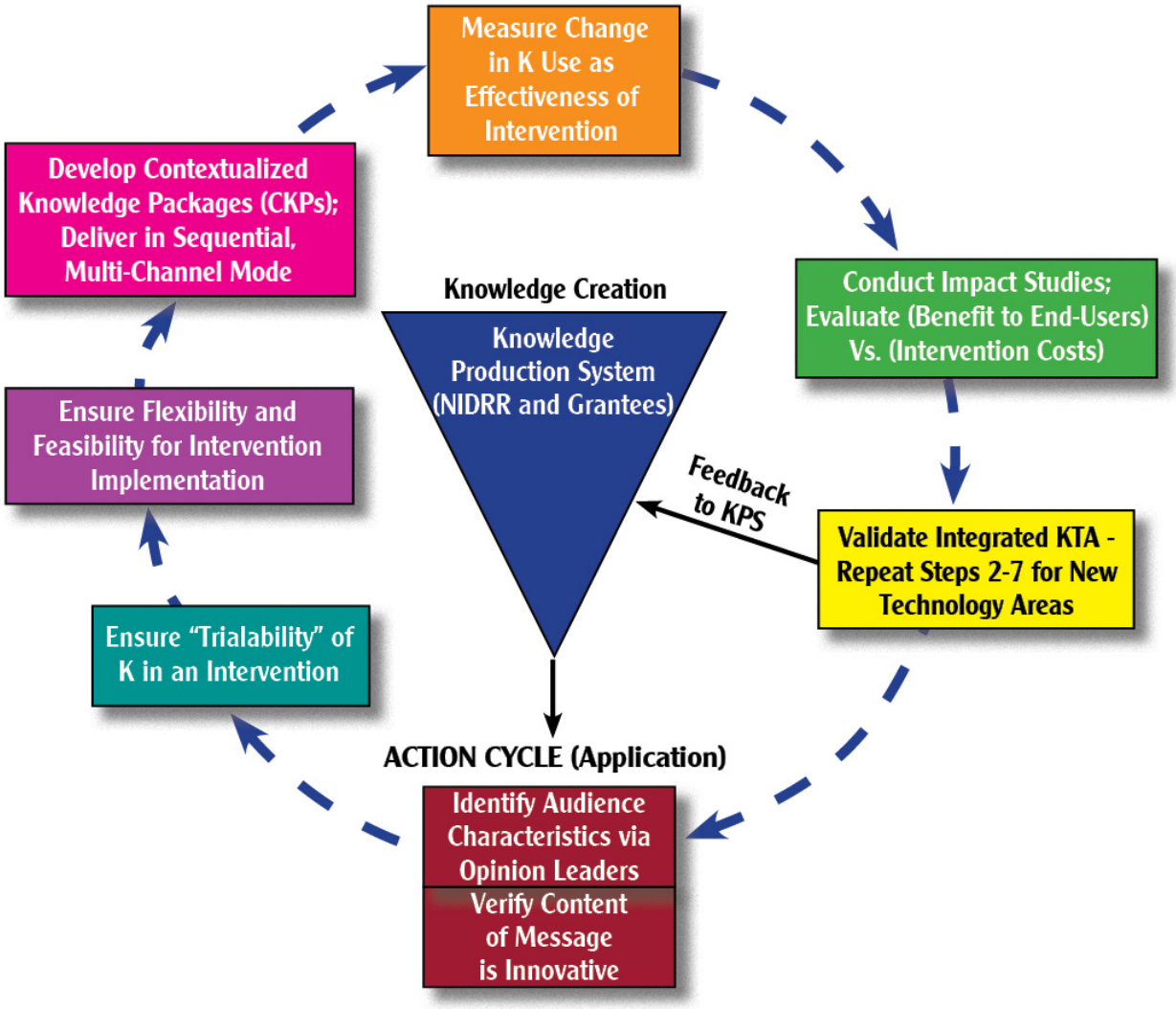

Fig. 3. Research Design for the KT Intervention Study.

	Baseline Assessment	Intervention Delivery	Post Test 1	Intervention Delivery	Post Test 2
R T_1	$O_{(1-6)}$	X_1	$O_{(1-6)}$	X_1	$O_{(1-6)}$
R T_2	$O_{(1-6)}$	X_2	$O_{(1-6)}$		$O_{(1-6)}$
R C	$O_{(1-6)}$		$O_{(1-6)}$		$O_{(1-6)}$

Fig. 4. AIUNK Survey Framework (Based on Halls et al, 2006)

		CATEGORIES					
		Being Aware	**Getting Information**	**Sharing**	**Assessing**	**Planning**	**Implementing**
LEVELS	**0 - NON-AWARENESS**						
	1- AWARENESS:						
	2 – ORIENTATION:						
	3 – PREPARATION:						
	4 - INITIAL USE:						
	5 - ROUTINE USE:						
	6 – EXPANSION:						
	7 –COLLABORATION:						
	8 – INTEGRATION:						
	9 – MODIFICATION:						