Using the Ranked Discrepancy Model to Identify Priority Topics for Professional Development for Agricultural Extension

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Abstract

In an ever-changing agricultural context, extension agents are expected to possess the competencies to provide relevant non-formal education to their clientele on persistent and emerging issues. This research note applies the Ranked Discrepancy Model (RDM) to assess priority topic areas for professional development activities in agricultural extension. The study followed a correlation design and gathered survey data from a sample of agricultural extension agents at Utah State University (n = 42). Results indicated the high priority areas for professional development irrigation technologies, weed control, post-farm activities (e.g., value-added products and marketing), and GPS technologies and drones for real-time monitoring. The study also showed the simplicity of the RDM in handling repeated-measures data, as the analysis was performed entirely in Microsoft Excel. The research note provides a replicable framework for researchers examining agents' professional development needs.

Keywords: needs assessment, professional development, competency, education

Introduction

An Agricultural Innovation System (AIS) is a dynamic collection of actors interacting with each other to strengthen the capacity of and partnerships between developmental organizations (Aerni et al., 2015; The World Bank, 2012). Organizations within an AIS include input suppliers, advisory services, and research institutions that are constantly responding to the evolving needs of farmers and stakeholders. Cano et al. (2023) discussed the complex interplay between farmers' demand for information and extension agents' capacity to meet that demand. Cano et al. (2023) argued extension agents are frontline workers; they directly work and partner with communities to facilitate the broad objectives of rural development. They operate in uncertainty, varying governmental agendas, and changing stakeholders. As the context evolves, extension agents are expected to possess the core competencies and subject matter expertise to provide relevant non-formal education to their clientele on persistent and emerging issues (Enciso et al., 2022).

The literature provides an in-depth analysis of competencies for extension agents (Ghimire et al., 2017; Graham, 2009; Harder et al., 2010; Lakai et al., 2014; Narine & Ali, 2020; Olorunfemi et al., 2020; Rodriguez et al., 2019). These studies assert that capacity-building efforts are tied to improving the core competencies of agents, such as program planning and evaluation, communication, educational methods, and leadership. Many of these core competencies are discussed in the literature and appropriately framed within McClelland's competency modeling approach (McClelland, 1973). As a result, the literature provides a robust framework for guiding competency professional development (PD) activities within an AIS. However, the complexity of pluralistic systems with multiple actors can create redundancies or lags in providing timely capacity-building programs beneficial to frontline extension workers (Cano et al., 2023; Enciso et al., 2022).

According to Lamm and Lamm (2018), extension organizations emphasize accountability and program impact; program planning and evaluation competencies are essential to capacity-building efforts (Suvedi & Kaplowitz, 2016). As a core competency area, subject matter expertise is the technical knowledge and skills an agent must possess to provide impactful education to clientele (Suvedi & Kaplowitz, 2016; Lamm et al., 2020). In most instances, an agent's subject matter expertise (or content knowledge) is first developed via formal education (e.g., a bachelor's degree) and then reinforced in continuous professional development activities throughout their career.

Within an ever-changing agricultural context, extension organizations must strive to ensure agents are equipped with the subject matter expertise to address clientele needs. Cook et al. (2021) provided a succinct review of the complex social environments in which agricultural extension organizations operate. Their review noted clients’ needs arose from changing socioeconomic conditions, environmental concerns, and social and cultural dynamics. Xu et al. (2023) also indicated agricultural technologies are developed in tandem with these changing conditions. In such dynamic environments, extension agents must be up-to-date in their area of expertise to successfully assist clientele.

Needs assessments are commonly conducted in extension to guide program planning efforts (e.g., Dooley et al., 2018; Narine et al., 2021). Such assessments are critical to providing relevant decentralized extension services to farmers as they drive the program planning process (Diaz et al., 2021). Examining emerging needs can lead to efficient resource allocation to

relevant programs for rural development. However, non-formal education providers must also ensure their agents possess the content knowledge on those emerging issues before seeking to address them. This can be a challenge given the rapid rate of change across agricultural systems. As such, there is a need to ensure extension agents possess the knowledge and ability in emerging topic areas to facilitate relevant and impactful extension education to a changing clientele base. This research applies the Ranked Discrepancy Model (RDM) to assess priority topic areas for professional development activities in agricultural extension.

Conceptual Framework

The literature provides many examples of competency assessments that inform targeted professional development for extension agents (e.g., Harder et al., 2013; Olorunfemi, 2020; Saleh & Man, 2017). Most competency research in extension was grounded in McClelland's competency modeling approach (McClelland, 1973), followed a standard needs assessment framework (e.g., Witkin & Altschuld, 1995), and applied the Borich model to analyze gaps in competencies (Borich, 1980). The Borich model draws on the tenants of andragogy as it examines agents' own perceptions of the importance of a competency to their specific role. Knowles (1984) indicated adults must grasp the importance of a topic before learning more about it; the adult learner is problem-centered, and the topic must be perceived as relevant to their job.

The Borich model has been applied numerous times in agricultural extension research (e.g., Murphery et al., 2018; Roberts et al., 2015; Oladele, 2015;). However, Narine and Harder (2021) outlined several limitations of the Borich model. Namely, the authors argued that the Borich model relies on a misuse of means to analyze single-item ordinal variables. Their argument was driven by the parametric nature of means as it relates to non-normally distributed ordinal data. Narine and Harder provided an alternative to the Borich model called the Ranked Discrepancy Model (RDM). The RDM was initially developed to handle Borich-type competency data and then applied to analyze and visualize repeated-measures data in a needs assessment (Narine & Harder, 2024). Since its publication in 2021, the model has been successfully applied in several studies across different disciplines, contexts, and countries (e.g., Choi & Park, 2023; Flanagan et al., 2023; Seitz et al., 2022; Zickafoose et al., 2023).

The RDM maintains the conceptual logic of the Borich model and is consistent with McClelland's competency modeling approach and the tenets of adult learning (Narine & Harder, 2021). While its application is rooted in competency and needs assessment data, the model is also appropriate for handling ordinal repeated-measures data in a programmatic needs assessment. With an established need to equip extension agents with the competency to address the evolving issues facing clientele, this Research Note provides an application of the RDM to examine persistent and emerging topic areas for professional development in agricultural extension in the U.S., particularly in Utah. While the Research Note was not intended to and does not provide a comparison of the RDM to the Borich model, Choi and Park (2023) conducted a comparison study. This study demonstrates the application of the RDM to preparing agents with the skills to meet farmers' changing needs.

Purpose and Objectives

The purpose of this Research Note was to demonstrate the application of the RDM to identify priority topic areas for professional development in sustainable agriculture. The

objectives were to (a) identify topic areas relevant to sustainable agriculture, (b) assess gaps in extension professionals' ability to provide relevant education on each topic, and (c) rank priority topic areas for professional development. The study provides a replicable framework for professional development experts seeking to understand gaps and needs in their organizations.

Methods and Design

The professional development assessment followed a correlational design (Ary et al., 2006) and gathered survey data from a sample of agricultural extension agents at Utah State University (USU) Extension. The population of agents at the time of data collection was 95 (N = 95). An online survey was used to gather data, and with a 44% response rate, the final sample consisted of 42 agents (n = 42). The study was determined exempt by USU Institutional Review Board. Data were collected in February 2024.

The administrative team at USU Extension developed and reviewed the survey. The Director for Agriculture and Natural Resources led the team. The primary goal of the assessment was to determine priority training topics for ongoing professional development in extension. The administrative team is typically responsible for planning continuous learning opportunities for agents by allocating resources to high-priority topic areas. First, a list of topics was developed from a review of existing extension programs. Then, the team used ChatGPT to corroborate the existing list and add emerging topic areas. The prompt to generate a list of topics was "*Create a list of specific topics in the area of sustainable agriculture*." Then, the follow-up prompt was "*Create individual sub-topics for each topic area*." The prompts led to 36 topics, with 17 overlapping with the existing list. After review and refinement, the Director for Agricultural and Natural Resources at USU Extension reviewed the list one final time to ensure its completeness and relevancy. The final list contained 40 topic areas.

The self-assessment followed a repeated-measures design, and respondents were asked to rate each topic on a 5-point Likert-type scale using the following question prompt: Please indicate – (a) How *relevant* each topic is to your primary target audience (i.e., Relevance), and (b) Your *ability* to provide education on each topic to the target audience (i.e., Ability). The 5-point scale for Relevance was as follows: Not relevant – 1, Of little relevance – 2, Moderately relevant – 3, Relevant – 4, and Very relevant – 5. The Ability anchors were as follows: None – 1, Below Average – 2, Average – 3, Above Average – 4, and Excellent – 5.

Narine and Harder (2024) provided a step-by-step guide to applying the RDM in similar assessments. Following a needs assessment framework (Witkin & Altschuld, 1995), the RDM measures the *gap* between a *current* and *desired* state or condition (Narine & Harder, 2021; 2024). Guided by Witkin and Altschuld (1995), the proxy indicator for the current state was the agent's *ability*, and the desired state is the topic's *relevancy*. Therefore, a gap (or need) existed when agents had less than sufficient ability to teach a relevant topic area. An *equilibrium* existed when agents' ability matched the topic's relevancy, and a gap did not exist at equilibrium (i.e., ability = relevancy) or when agents' ability was greater than the topic's relevancy.

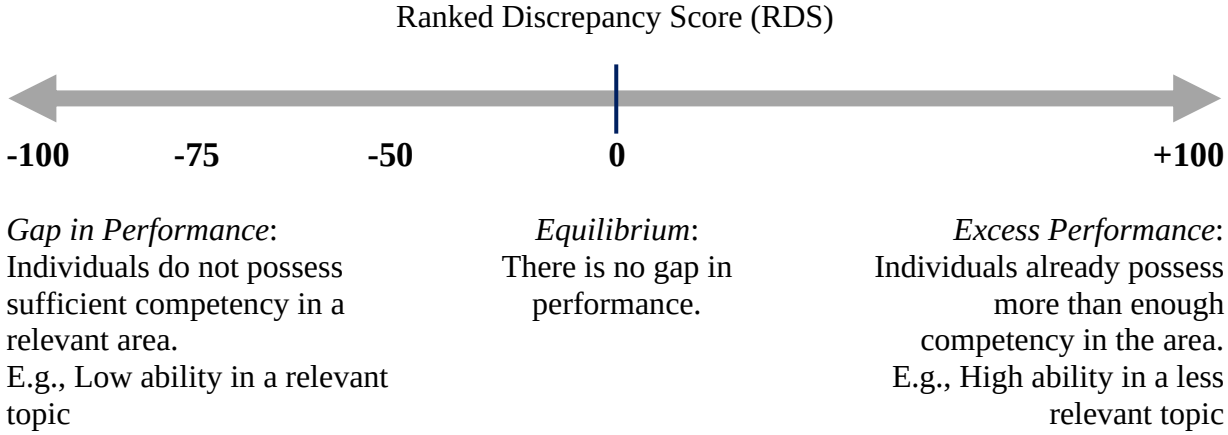
The response anchors used in this study to measure the current and desired state differed from the format typically applied in Borich-type assessments (Borich, 1980). The Borich model examines the gap between individuals' self-assessed ability and the sample's perceived *importance* of a competency item (e.g., Oladele, 2015). Therefore, the inherent logic of the Borich model hinges on a gap comparison between ability and importance ratings. Narine and Harder (2024) demonstrated the applicability of the RDM in a repeated-measures design when

the proxy conditions differed from established anchors. For example, the original application directly compared the RDM to the Borich model by assessing the gap between ability and importance in a professional development context (Narine & Harder, 2021). In the succeeding application, the authors compared the RDM to a paired *t*-test by assessing the gap between satisfaction and importance in a community needs assessment context (Narine & Harder, 2024). In both applications, the RDM was a reliable estimate of gaps in a repeated-measures design with ordinal variables for proxy indicators. Therefore, the RDM was deemed appropriate for the analysis since it was developed to handle repeated-measures data from a needs assessment.

The Ranked Discrepancy Score (RDS) shows the magnitude of the need (i.e., gap) for training on a specific topic area. The RDS ranges from -100 to 100, with a negative score signifying a gap (or need), a score of 0 representing equilibrium, and a positive score indicating a surplus of ability. Figure 1 shows the range and interpretation of the RDS. The data were analyzed in Microsoft Excel following Narine and Harder's (2024) process.

Figure 1

Interpretation of the RDS



Most agricultural agents in the sample had less than six (6) years of experience (45%, *n* = 19), 26% (*n* = 11) had six (6) to 12 years of experience, and 29% (*n* = 12) had more than 12 years of experience. Agents were asked to rank the clientele type they worked with the most; almost all agents interacted the most with farmers and/or ranchers. Most agents stated their area of expertise was general agronomy (62%, *n* = 26).

Results

Table 1 shows the overall ranking of topics based on the need for professional development for the entire sample. Out of the top five (5) priority topic areas, five were related to water conservation (water rights policies, water-efficient irrigation systems, precision irrigation technologies, smart irrigation systems, and water-efficient crops), followed by weed control, marketing strategies, value-added processing, and drones and sensors. Based on the RDS, there were gaps across all topic areas except for dairy goat production. However, given limited resources for professional development, it was recommended to the administrative team that professional development focus on topics ranked one (1) through five (5).

Table 1

Priority Topics for Professional Development (n = 42)

Rank	Topic Area	RDS
1	Water rights policies	-69
2	Water-efficient irrigation systems	-64
3	Precision irrigation technologies	-60
4	Smart irrigation systems	-55
4	Water-efficient crops	-55
4	Sustainable weed control for agriculture	-55
5	Marketing strategies for sustainable products	-52
5	Value-added processing for agricultural products	-52
5	GPS-guided drones and sensors for real-time monitoring	-52
6	Drought mitigation for agriculture	-50
7	Soil sensors and monitoring technologies to assess soil health	-48
7	Multispectral and thermal imaging cameras for crop monitoring	-48
8	Satellite-based monitoring for precision agriculture	-45
8	Sustainable land use and planning	-45
9	Natural predators specific to pests	-38
9	Rotational grazing plans	-38
9	Drought-resistant forage crops	-38
9	Beef cattle production	-38
9	Rangeland management	-38
9	Wildlife depredation protection for agriculture	-38
10	Heat-tolerant crops	-36
10	Nitrogen-fixing trees for soil fertility	-36
10	Blockchain technology for supply chains	-36
11	Crop rotation plans to combat pests	-34
12	Drought-tolerant native plant species	-33
12	Windbreaks with drought-tolerant tree species	-33
12	Farm robots with AI for precision tasks like seeding and weeding	-33
13	Cover cropping practices	-24
13	Community-supported agriculture (CSA) models	-24
14	Working with native communities to integrate traditional farming practices	-21
15	Organic amendments for soil enrichment	-19
15	Small ruminant (sheep/goat) production	-19
16	Trap cropping to mitigate pest damage	-17
16	Vegetable production	-17
17	Strategies for erosion prevention	-12
18	Mulching practices	-10
19	Rainwater harvesting techniques	-7
19	Equine education	-7
20	Dairy cattle production	-2
21	Dairy goat production	0

Note. All 40 items were ranked based on the RDS, with tied items receiving the same ranking.

Figures 2-4 show the high-priority items based on the RDS by agents' years of experience. The results were provided to demonstrate the application of the RDM by subgroups, as done by Narine and Harder (2024). The analysis by subgroups was conducted using Pivot tables in Excel. Findings illustrate differences in priority topics for professional development based on years of experience. While water-related topics were ranked high across all groups, GPS-guided drones and sensors was ranked notably higher for early-career agents (RDS = -68) compared to mid-career agents (RDS = -55). This item was ranked relatively lower for late-career agents (RDS = -25).

Figure 2

Priority Topics for Early-Career Agents (< 6 Years of Experience) (n = 19)

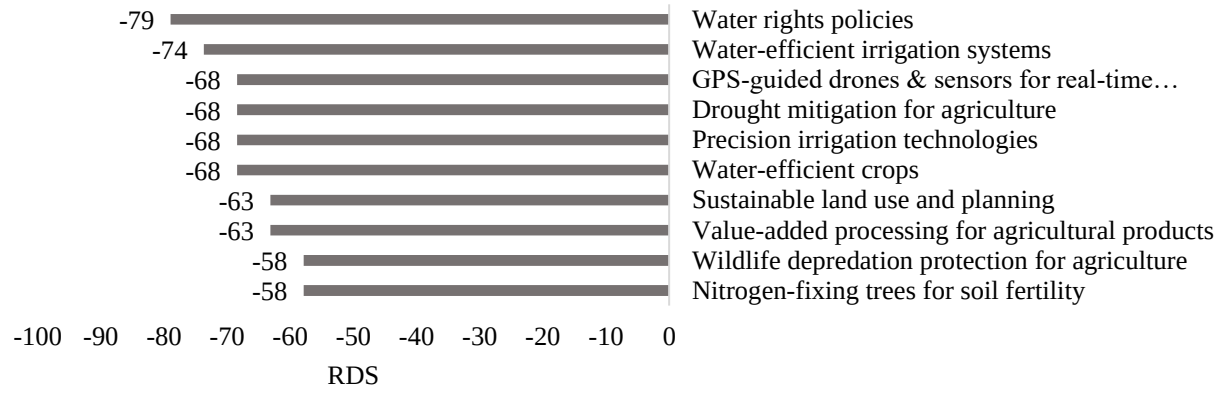


Figure 3

Priority Topics for Mid-Career Agents (6-12 Years of Experience) (n = 11)

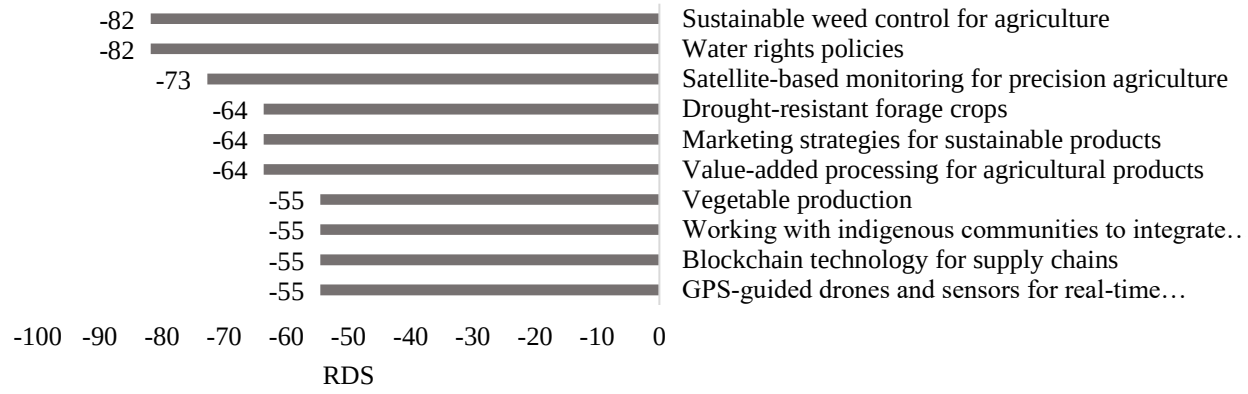
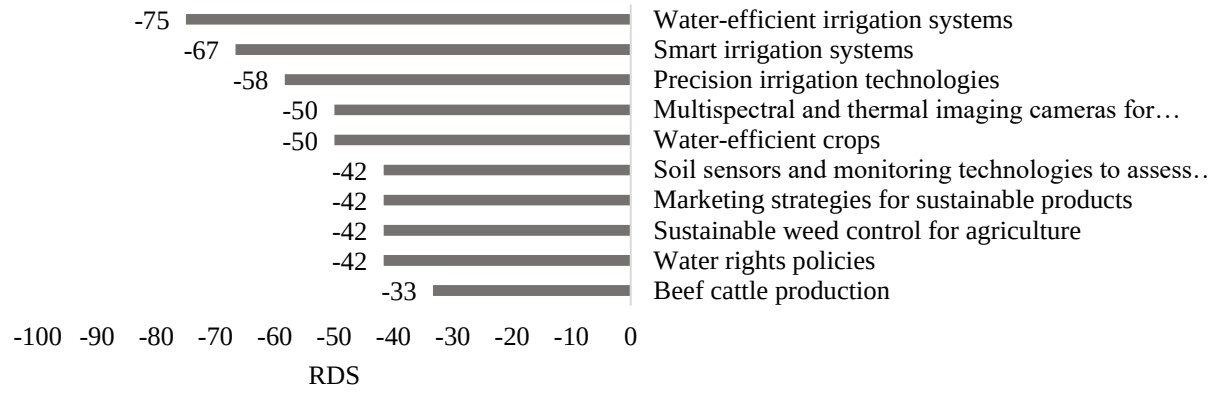


Figure 4

Priority Topics for Late-Career Agents (>12 Years of Experience) (n = 12)



Discussion, Conclusions, Recommendations

The purpose of this Research Note was to demonstrate the application of the RDM in a programmatic needs assessment to identify priority topics for professional development in agricultural extension. With an ever-changing clientele base, the study applies a simple approach to understanding gaps in agents' ability to deliver education on persistent and emerging topic areas to clientele. The process follows Narine and Harder's (2021; 2024) procedure for handling repeated-measures data, and the analysis was performed entirely in Microsoft Excel. The study illustrates the model's simplicity in determining gaps for the whole sample and between subgroups. Narine and Harder (2024) showed that the RDM was designed to examine needs by subgroups (e.g., needs by agent characteristics). The model was also appropriate due to the ordinal nature of the variables, the small sample size, and the use of proxy indicators in a repeated-measures design.

The findings showed that high-priority areas for professional development were related to efficient water use on farms, weed control, post-farm activities (e.g., value-added products and marketing), and GPS technologies and drones for real-time monitoring. In addition, the analysis by subgroups showed that GPS and drone technologies were ranked higher for early-career agents. Program administrators might be interested in understanding the professional development needs of early-career faculty to inform onboarding and learning opportunities for new agents. The priority topics resonated with the extension administrative team at USU Extension, especially given the increasing prevalence of drought and extreme weather events. After discussing the results, the team actively sought professional development opportunities for agents to equip them with the knowledge and ability to address the topics in their extension programs.

While this study focused on priority topics for professional development in one subject matter, the literature also provides a wealth of evidence on the core competencies for extension agents. Core competencies generally relate to the skills needed to perform extension work, while the topic areas identified in this study are content knowledge needed to provide education to a specific group of clientele. For example, Suvedi and Kaplowitz (2016) outline several core competencies, such as program planning, evaluation, and communication.

Given the complexities of an AIS, as described by Cano et al. (2023) and Enciso et al. (2022), extension organizations should aim to prioritize capacity-building efforts for agents. With rapid changes in agricultural technologies and socioeconomic conditions across agricultural and developmental contexts, actors in the AIS must be proactive in their approach to building the

capacity of extension educators. Limited resources must be allocated to high-priority topic areas to ensure agents can meet farmers' demand for information and education (Cook et al., 2021). The literature underscores the need for ongoing programmatic monitoring via needs assessment and program evaluation to ensure extension effectively and efficiently serves its clientele while striving to meet rural development goals. Capacity-building efforts in extension will continue to be a central focus of development organizations in any AIS.

Based on the literature, the RDM produced results consistent with the Borich model (Narine & Harder, 2021) and a paired *t*-test (Narine & Harder, 2024). The RDM does not rely on sample size, distribution, or parametric assumptions. However, the authors noted sample size remains an important consideration when conducting needs assessments. This study has three (3) major limitations: the sample size was small, the instrument was only reviewed by a small team at USU, and the instrument was not pilot tested by the target audience. We recommend that researchers seeking to conduct similar assessments take the appropriate steps to ensure face validity. We encourage researchers to replicate the assessment in their extension organizations to examine agents' professional development needs. AIS organizations should aim to provide continuous and relevant professional development opportunities to build agents' subject matter expertise. Capacity-building in extension is necessary to ensure a responsive and effective AIS for rural development.

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