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7. Title New Paradigm for Discovery-Based Learning: Implementing Bottom-up Development by Listening to Farmers' Needs and Using Participatory Process				
12. Investigator Name(s) (Last Name and Initials) Dunkel, F. V.; Montagne, C. A.				
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Outputs: A new teaching model Expansive Collaboration (ECM)(Dunkel et al.2011) emerged connecting food/agriculture issues to specific communities-of-focus [COF] with action research/service-learning using the holistic process. Students collaboratively build on previous students' research to answer COF needs. ECM is used in: MSU-Bozeman Depts. Plant Science/Plant Pathology, Land Resources/Environmental Sci., Modern Languages. Other Colleges, Liberal Studies, Ed, consider adoption. MSU; high, middle, grade schools in MT, VA, Mali observed MSU faculty engage students/COF in malaria eradication, now work on kwashiorkor. MSU faculty/students use ECM with Native American students on Crow, N/Cheyenne, Blackfeet, Wind River Reservations, MT family farm/Hispanic families. Intercultural Gaps were identified in film, Dancing Across the Gap (DAG)(Chaikin et al.2010) aired on MT PBS, YouTube www.montana.edu/ mali/hpvideos. html (est. 4,000+ viewings). Premier events were held at: N/Cheyenne Reservation; USDA-NIFA; Bozeman MT; Sanambele, Mali. N/Cheyenne tribal community college, Chief Dull Knife College (CDKC) held DAG Week. Film is: used in CDKC/high/grade schools, detention centers, Smithsonian Native American Museum staff training; courses at MSU (Plant Sci, French), Purdue (soils), U of St. Thomas MN (sociology); in review for MT Indian Ed for All required K-16 public education. Student/faculty published 134 articles/videos, held 62 community/professional events attended by 10,402 persons. MSU students/faculty discovered holistic process may resolve local water rights conflict. CDKC instituted a beneficial international research program. Private, urban, liberal arts U of St. Thomas, incorporated agriculture issues permanently into engineering, sociology, French courses. UC-Riverside created honors course linking College of Natural/Agricultural Science, College of Humanities, Arts, Social Sci. UC-Davis Plant Path faculty included undergrads in USAID IPM CRSP-Mali project. U of MT linked MSU, U/Bamako-Ag for perceptions study (Halvorson et al.2011) in Niger River Inner Delta villages where water quality causes 40-60% child mortality. U/Bamako, Ag Institute/US faculty learned urgency of knowing community perceptions through using holistic process before implementing ag marketing chain, village-based technology improvements: neem leaf slurry for malaria mosquito larvae (Luong et al. in rev.); shea quality analysis kit (George et al.2011); traditional wisdom (zeer pot)-based seed potato storage; evaporative cooler; shea protection of cowpeas postharvest; sand filtration/wetlands (Ba 2008)/solar water purification. 131 students completed overseas (Mali) program, 598 in on-campus/reservation programs at 6 universities and a tribal college. 41 % of US students in-Mali program chose careers in food, health, agriculture, wildlife mgt, communications. Former students use holistic process at community level: at Oxford University as Rhodes Scholar; in/completed MBA, MD, DDS, DVM, PT nursing programs, MS/PhD programs in ag/health/forestry. Graduates have jobs in: Peace Corps; US Forest Service; biomed/ag research/teaching; communications; Head Start, N/Cheyenne Reservation.				
Outcomes/Impacts: Using the Expansive Collaboration Model (ECM) for community-based research/service-learning (Dunkel et al. 2011) developed with this grant, we demonstrated how global food security/health issues are solved by a village sustainably. ECM uses the holistic process and on-site mentors to facilitate villages achieving their desired quality of life with their own resources. E.g., in Sanambele, Mali, incidence of malaria deaths in children decreased to zero after students/faculty facilitated dry-season larval management, mosquito/protozoan life cycle storytelling, a women's handicraft cooperative www.mmama.net and micro-loan system. Sanambeleans now work with MSU students/faculty on kwashiorkor. Our experiential program expanded to Native American Reservations in MT/WY, Mongolia, and Morocco (MSU); Appalachia (VTech); Ghana (University of St Thomas-St Paul MN). Using ECM, we addressed previously unmet Millennial Gen 18-25 year olds' needs to understand traditional ecological knowledge (TEK) and its relationship to poverty issues. Project evaluation showed our students gained in understanding poverty, its cultural nuances/solutions. However, 92% of 47 MSU College of				

Ag students (18-22 years) who never took our courses, thought TEK useful in formal science learning, but 45% cited no TEK experience. Moreover, 21% believed TEK is perceived negatively/skeptically by scientific, agriculture, wildlife, health management communities. Workshops for professors to acquire these new pedagogical skills were held in 2011 (planned in 2012). Students/faculty, helped by the USDA HEC grant, discovered positive impacts of having skills to bridge cultural gaps to improve food security and to understand food choices, e.g., edible insects. Input from faculty, Malian villagers, Native Americans, students will be shared January 2012 invited by FAO (United Nations), and on new website www.foodinsectsnewsletter.org. The Virtual Teaching/Learning Center for Alleviating Rural Poverty and valuing TEK www.montana.edu/mali, is an important outcome of this grant connecting faculty/communities with Native American communities and internationally. This permanent knowledge resource helps faculty create courses using the holistic process and a community-of-focus. Students use the Center for undergraduate capstone research and M.S. thesis research. Village home-stays are now solely supported by MSU Undergrad Scholars program, instead of by USDA. The Center promotes community storytelling to exchange agricultural, environmental, health knowledge. MSU students/faculty collaborated with a Sanambebe storyteller, 5th-6th grade students/teachers to capture/illustrate a traditional story, creating a primer to learn required French, English. Inspired by our Center, VTech's Appalachian Studies Program designed a course using the holistic process with storytelling to exchange ag-information supporting Appalachian's community gardens. This grant created a U.S. place for faculty/students to find ideas, information, and skills to use the holistic process to listen, learn about the history/culture of the specific community-of-focus, appreciate a community's TEK and facilitate solving poverty issues.

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Participants:

PIs, entomologist Dunkel, soil scientist Montagne, worked with no pay as a team with other MSU faculty in French, Plant Path, Environ Eng, Plant Sci, and 7 other US/Mali institutions. Dunkel maintained programmatic contact with institutions via weekly phone conferences, semi-annual visits. Webmaster, film producer/videographers, visiting author (Ayithey), T/As received pay. We began with 6 partners, 2008 added U of MT. Intense work on PBS film at Chief Dull Knife College (CDKC), N/Cheyenne Reservation, led to new family, elder relationships and new community-of-focus for MSU course AGSC 465R also resulting from grant. At private, urban, service-based U of St. Thomas (UST), St Paul, MN, grant stimulated many collaborations: Mech Eng; Sociology; Communications; French; Business Mgt; Accounting. Initially, VTech, UC-Davis' project focus was IPM CRSP-Mali (entomology, plant path). By project end, linkages developed with VT Biology, Ag Econ, Appalachian Studies Program, UC-Davis Art/Science Fusion program. UC-R linked new honors course in Ag with College of Humanities, Arts, Social Science. These diverse US institutions engaged in closely-related academic activities, collaborated with 5 Malian institutions, Peace Corps, village schools, U of Bamako Institute of Ag, Mali natl ag research org (IER), on-site Malian mentors. Faculty at all 12 institutions: shared curricula design, materials development, evaluation strategies, student advising. Inter-institutional program delivery; linked undergrads/grads at 1862 Land Grants, tribal community college, private, service-based university, West African university/ag research system. UST collaborated with NGOs Compatible Technol. Internat., St. Paul MN and Shea Yeleen, N.Y. MSU faculty developed Mali-based NGO, Nine Villages www.ninevillages.org using holistic process to provide mini-loans to subsistence villages. In Sanambebe, Mali villagers developed women's handicraft cooperative marketing globally www.mmama.net collaborating with MSU faculty/students. Entrepreneurial incubator Mali ABC was launched. 6 institutions developed courses espousing holistic process. Statements of 131 students working in Malian villages in past 12 years, confirmed major impacts, e.g.: "The USDA challenge grant gave me confidence/insight into developing a career as an international scientist. The program taught me how to develop a project with a team of local scientists. Working with Malian scientists I learned how important it is to learn from one another while developing foreign aid project strategies. By traveling

to Mali I learned how interwoven culture/tradition are with the land. I also learned how important it is to understand this culture and needs of rural people before putting money into an unwanted project. The Malian extern program has worked with MSU students/Malian scientists for many years. Since this project is long term people are incredibly invested in the work going on in Mali. This is an important lesson I learned in developing successful projects." (Ashley Lehman who published MSU undergrad research in J. of Ethnopharmacology, completed U of MT M.S. in ethnobotany, now is scientist in US Forest Service).

Target Audiences:

Students, faculty, administrators at all institutions of higher education, including tribal colleges, USDA NIFA are target audiences for these innovations aimed at transforming US agriculture. We saw our innovations appreciated by: families, elders in N/Cheyenne, Apsaalooke, Blackfeet, Eastern Shoshone Reservations, a Tlingit community; Bambara, Fulani, Bozo, Dogon subsistence farmers, fishermen, herders in Mali; MT seed potato farming communities. Our wide network grew by observation, word-of-mouth on our 7 US campuses and at national/regional professional meetings: NACTA; Entom. Soc. of Amer.; Amer. Assoc. of Teachers of French; Soc. Plant Path.; Assoc. Internat. Ag. Extension Ed.; IPDN workshop; MN Civic Engagement Forum on Environ. Sustainability; Midwest Sociological Soc; NC 213 Grain Quality/Marketing. Our detailed brochure met thousands of information requests, as did our website www.montana.edu/mali, a PBS film viewed by est. 4000+ persons. Longitudinal analysis of one of 4 expansive collaborations in project revealed 16,745 US/Malians were impacted by work of students, faculty, scientists, NGOs with shea butter. We are committed to continuing these dissemination paths as well as increased use of peer-refereed journals and completion of podcast series for higher education faculty/administrators. Podcasts are aimed at raising awareness about the importance of use of the holistic process, intercultural competency, traditional ecological knowledge in teaching the generation that will institute sustainable agriculture practices in the US. 134 results of innovations in discovery-based learning were published/in press in venues such as videos, journals, such as: NACTA Journal; Health and Place; Environ. Entom.; J. Gen. Virology; Mol. Plant Pathol.; J. Internat. Ag. and Extension Ed.; Internat. J. Sustainable Energy; Arch. Virology; Internat. J. of Service-Learning in Engineering; J. Ethnopharmacology. 3 books on intercultural issues, 3 chapters of service-learning books were published/in press. Results of student initiated original research were contained in 5 MS theses and presented at 4 annual UST Engineering conferences, 4 MSU-Bozeman Student Research Celebrations, 62 community events. There were over 27 popular press articles, TV appearances. Symposia on the teaching/learning innovations were presented at: meetings of Entomological Society of Amer (Dec 2009); Conference on World Hunger (Ap 2010); the annual conference of American Association of Teachers of French (Jul 2010); FAO of the United Nations (Jan 2012); Natl Conf. on Service Learning in Engineering; National Soc. of Experiential Education Conference; International Service-Learning Research Conference; MT Higher Ed Indian Education for All Annual Conf. Results of original research by students were presented at: ann. natl. mtgs of Amer Society of Agronomy, Crop Science Soc. of Amer.; Soil Sci Soc of Amer; Entomol. Soc. of Amer; NC213 (Mgt of Grain Quality/Security in World Markets); Engineers for a Sustainable World. Additional communication methods are partner websites www.bioregions.org, www.mmama.net, foodinsectsnewsletter.org, <http://courseweb.stthomas.edu/cmgeorge/>

Project Modifications:

No major changes, few substitutions in objs. made: Obj.1 Introduce rural poverty/subsistence farming issues across campuses. Completed at 7 US institutions. Obj.2 Infuse holistic, participatory, bottom-up, "Farmer First" processes into partner's extern programs with Mali mentor guidance (Mali Agribusiness Center [ABC]). Completed. Obj.3 Initiate UC-Riverside (minority-serving institution) Mali extern program, in Insect Molecular Bio using local materials solutions to malaria. Co-PI initiated extern program, but had multiple family emergencies, early retirement, so most externs could not complete in-Mali part. A strong malaria project emerged led by UC-Riverside Asian student, Mali extern. U of MT. initiated new extern program. Obj.4 Produce concept, how-to video series (Engl/Fr) by student-mentor teams facilitating intro of holistic communication skills into curricula at 8 partner schools addressing issues emerging from discussion (#1,2 above). 14 hours footage captured, used by partners for on-campus immersion. Partners/other faculty interviews extensively described 12 podcast series. Concept/how-to videos in progress. Obj.5 Expand grad student participation (UST MBA students; MSU plant path) interested in international agriculture, to learn participatory process/holistic thinking skills/develop new paradigm of sharing technologies with potential adopters. Completed. Expanded to Health Science grad students. Obj.6 Lengthen overseas 2 wk externships to 3-6 wks mentored by U of Bamako faculty/natl ag scientists (Mali ABC). 3 highly successful solo externships completed with excellent on-site mentor participation: industrial engineering; environmental science; health. Mentors now work with students via e-mail/Skype. Longterm externships were requested by village middle school faculty. Obj.7 Explore feasibility of similar, mentored undergraduate opportunity for experiential learning initiated in Mongolia with nomadic communities. Completed. Obj.8 Capture program outcomes in 28-min PBS film in award-winning on-line series

Terra to report impact to US taxpayers. We expanded output with 56-min film for PBS regular programming. 14 film segments on YouTube satisfies some of obj 4. 2 Products proposed for which substitutions made: 1. Cross campus reading/reflection with written output on understanding rural poverty in material-resource-poor communities. Completed via MSU Liberal Studies, Honors Program, French, Engineering courses. Although Freshman Seminar instructors refused inclusion, seniors designed proposal to amend this. 2. Interdisciplinary course designed by tribal college CDKC "Beyond Poverty: traditional concepts of sharing, conflict resolution, and family values" shared electronically at 7 MT Tribal Colleges, project courses, freshman seminars across US. Instead of formal course, an on-going informal venue emerged naturally for exchanging views of culture (including subsumed cultures) between CDKC students, N/Cheyenne elders, MSU N/A students, non-native students/faculty. This exchange model is now used with Tlingit (Hoonah, AK), Apsaalooke, Blackfeet, E/Shoshone communities, each related to community-based research using holistic process.

Approved (Signature)	Title	Date

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