



UNIVERSITY OF SOUTHERN MINDANAO
Kabacan, Philippines



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CAPSULE PROPOSAL FOR EXTENSION

A. BASIC INFORMATION	
1. Project Title	Strengthening Barangay High Schools: Validating and Implementing Representation Approach-Based Learning Materials for Independent Study of Mathematics in Remote Schools
Component 1	Building Capacity for Teachers in Instructional Development
Component 2	Building Capacity for Teachers in the Conduct of Action Research
Component 3	Design and Development of Representation Approach-Based Learning Materials for Independent Learning of Mathematics
Component 4	Validation and Packaging of Representation Approach-Based Learning Materials for Independent Learning of Mathematics
Component 5	Implementation of Representation Approach-Based Learning Materials for Improved Learning of General Mathematics
2. Proponent/s Indicate Name Designation, Office	Leorence C. Tandog, Debbie Marie Verzosa, Jonald Pimentel Philip Lester Benjamin, Leonard Paleta, Anna Jean Sebastian, Jupiter Pilongo, Daryl Mae Catubig, Lawton Yabes, Roel Valenton, Shandra Nanding, Rowel Madio Faculty, College of Science and Mathematics
2.1. Email Address	lctandog@usm.edu.ph
2.2. Contact Number	09466115568
3. Lead Unit/College	College of Science and Mathematics
3.1. Collaborating Unit/College	Graduate School – USM
3.2. Partner Agency	DepEd - Cotabato



CAPSULE PROPOSAL FOR EXTENSION

<p>4. Thematic Area</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Quality Learning Skills Development and Literacy <input type="checkbox"/> Food Security and Poverty Reduction <input type="checkbox"/> Social Development, and Strong Institutions <input type="checkbox"/> Good Health and Well-being <input type="checkbox"/> Preservation of Culture <input type="checkbox"/> Innovations in Science, Engineering, and Technology <input type="checkbox"/> Environmental Protection, Conservation, and Risk Reduction <input type="checkbox"/> Sustainable Entrepreneurship and Management
<p>5. Sector/Discipline</p>	<p>Mathematics Education</p>
<p>6. Project Duration</p>	<p>One year</p>
<p>7. Project Service Area/s:</p>	<p>DepEd Cotabato</p>
<p>8. Total Budget Requested (Php)</p>	<p>50,000</p>
<p>B. TECHNICAL DESCRIPTION</p>	
<p>1. Need-based Rationale</p> <p>(State rationale based on current set-up, the need, your solution, and connect) please refer to Magbanua, G.G. (n.d.) Writing a Need-based Rationale for Extension Proposal, <i>TeknoGiya</i> University of Southern Mindanao.</p> <p>Barangay high schools, formerly known as barrio high schools, were established in 1964 to provide wider access to secondary education (Orata, 1979). Since then, additional barangay high schools have opened with the passage of RA 6054 or the "Barrio High School Charter" in 1969. The establishment of barangay high schools is considered as equalizing opportunity for all Filipino children to access education regardless of their place of residence or economic condition.</p> <p>The performance of Philippine barangay schools has always been viewed to be inferior. In 1987 the Department of Education (DepEd) temporarily halted the opening of barangay high schools with acknowledgement that the quality of instruction in most of the barangay high schools suffered as evidenced by poor results in national achievement tests (DepEd DO 69, s. 1987). The quality of education in barangay high schools could not be sufficiently maintained due to a lack of experienced teachers and funding (Ishida, 1995) resulting in a lack of quality material resources and infrastructures (Bai, 2023). However, due to the insistent demand of the local communities for secondary education and the pressing need to improve access to education in remote areas, barangay high schools continued to operate and increased in number.</p>	



UNIVERSITY OF SOUTHERN MINDANAO
Kabacan, Philippines



CAPSULE PROPOSAL FOR EXTENSION

Teacher shortage is a critical issue in many rural areas around the world. This shortage is magnified in barangay high schools which serve as entry employment for inexperienced teachers who at the same time are forced to teach out-of-field subjects due to teacher shortages or limited class sections to handle in remote schools. Covid 19 exposed the challenges of the digital divide and students in barangay high schools were further disadvantaged because they had no access to materials and tools needed for remote and independent learning (Gutierrez and Bilefsky, 2021). These challenges continue this post-pandemic as DepEd schools continued cancelation of face-to-face classes or shortened class periods during extreme weather conditions.

Self-regulated and independent study is vital in cases where teachers are not available to facilitate learning. Effective learning materials significantly support independent learning since resources that can be learned without needing the assistance of a teacher can empower students to take control of their studies, learn at their own pace, and develop self-discipline and independent thinking. Research shows that supplemental printed materials significantly facilitate successful learning of math concepts (Brown and Gilmer, 2009) and self-instructional worked examples are effective in the development of both conceptual and procedural knowledge (Sheldon, 2013).

In 2021, we initiated a multi-dimensional approach to respond to the challenges that emerged from the urgent educational adaptations driven by the pandemic through material and technology tools development. Our project introduced teaching innovations that utilized interactive elements, visual features, storytelling, and manipulable representations. Various studies have shown that these features and tools enhance learning (De las Peñas & Bautista, 2008), facilitate visualization (Taka, Taka, & Budinski, 2010), and develop creativity (Shelomovskiy & Nosulya, 2012). Representation is an important element in the study of mathematics and is considered at the heart of cognitions associated with mathematical activity (Kaput, 1987).

The results of our study showed significant improvements in students' understanding of mathematics and science concepts. Anchoring from the positive outcome of the research project, the faculty and graduate students of PhD Ed and MST Mathematics programs engaged lesson study, produced research lessons and Learning Activity Pages (LAPs) that use various representation approaches. The learning resources are designed in a manner that students can learn essential concepts and skills with minimal support or even without the assistance of a teacher. The initiative established a structure for a Professional Learning Community (PLC) where teachers and experts work collaboratively for professional development and improved quality of learning. This endeavor provided a venue for sharing and transfer of pedagogies. The materials are now ready for validation and use by target students, thus this project.

The proposed implementation of representation approach-based learning materials for independent study of mathematics concepts aims to address the scarcity of quality teachers and other unique educational challenges faced by students in barangay schools and promote equitable access to quality education for all Filipino students regardless of geographic location. The rationale behind this extension project is rooted in several key considerations:



CAPSULE PROPOSAL FOR EXTENSION

1. **Mitigating the effect of teacher scarcity/unavailability.** In the absence of quality teachers, students can utilize carefully designed self-instructional Learning Activity Pages (LAPs) to develop essential mathematics skills and concepts.
2. **Enhancing learning outcomes.** The learning material allows students to learn at their own pace ensuring the concept is fully grasped or the skill is learned before moving on to the next material. Students can fit their learning experience to their needs that could potentially lead to better learning commitment and engagement. It also encourages collaborative learning among students fostering a community where knowledge and skills are collectively constructed and shared.
3. **Promoting lifelong learning.** The materials do not focus only mathematics contents instead uses these contents as tools to develop important mathematics skills such as pattern recognition, measurement, number sense and problem solving; and soft skills such as critical thinking, and adaptability. Development of traits that allow students to learn new information and skills on their own is a key competency in our rapidly changing society. Self-guided study improves capabilities, enhances self-efficacy and unlocks student's full potential.
4. **Improving the status of education in barangay high schools.** Barangay high schools remain the least option for students. Most are underpopulated because the quality of instruction continues to be below par with municipal or national high schools. These schools serve the underprivileged and marginalized population and deserve all the support a university can extend. The learning materials can help improve the quality of mathematics learning in remote schools. Empowering barangay high schools will boost the image and credibility of this type of school as a provider of basic education. In the long term, an improved image of barangay high schools can offer a solution to the continuous overcrowding of municipal and national high schools.

Overall, this extension project aims to strengthen education in barangay high schools through development of quality material resources for independent study of mathematics thereby improving access to quality education among marginalized communities.

2. Objectives (State specific objectives based on Knowledge, Skills, and Attitude/Practice (KSA/P))

This project aims to enhance the mathematics education received by students in barangay high schools in DepEd Cotabato with the use of carefully designed and validated self-instructional learning materials. Specific objectives:

1. Strengthen math teachers' capability to develop representation-based self-instructional materials.
2. Engage teachers in collaborative work of developing research lessons and Learning Activity Pages (LAPs).
3. Validate, pilot-test, and refine LAPs to efficiently facilitate independent learning of mathematics concepts and skills.
4. Enhance mathematics performance and numerical literacy among barangay high school students through implementation of LAPs



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3. Expected Output/s (State in quantifiable form)

1. Teachers are empowered with knowledge and skills in designing and developing material resources that are effective for students' self-guided study.
2. A professional learning community is sustained where teachers and experts will continue to work collaboratively and share pedagogies for improved learning quality.
3. LAPs are created that are tailored to mathematical abilities and needs for independent study of target clients.
4. LAPs are validated, pilot-tested, and packaged and/or lesson exemplars are implemented for online uploading.
5. LAPs are used to supplement learning of important mathematics content and skills for improved numerical literacy among students in barangay high schools.
6. Students in barangay high schools improved in terms of mathematics performance and numerical literacy.
7. Final versions of LAPs are copyrighted.

4. Major Activities (Enumerate in chronological order the series of activities to be undertaken)

Development Phase:

1. Gathering of baseline data

- Use researcher-made mathematics achievement test and standardized (if available) numerical literacy test to gather data on current mathematics capabilities of students in Barangay High Schools.
- Conduct ocular visit and interview with teachers and school heads about existing materials/learning resources available in barangay high schools
- Use available secondary sources to describe the performance of barangay high schools in division/nationwide evaluations.
- Survey on the number of school graduates who continued to the next level of education (ex. junior to senior HS) or admission rate of graduates to universities.

2. Needs assessment

- Conduct diagnostic or pretest to identify specific needs of students that can be addressed through material development.
- Interview teachers to identify weaknesses of students that should be considered when designing the LAPs.
- Site visit to the target school and interview with school heads to identify other



CAPSULE PROPOSAL FOR EXTENSION

contextual factors that may be considered during project implementation.

3. Brainstorming, initial planning and training

The PhD and MST math programs in coordination with the Department of Mathematics and Statistics have already organized the activity and established collaborative partnership between teachers who prepared research lessons on some topics and developed. However, this activity will be furthered as the project will engage barangay high school teachers in the collaborative work so that their perspective can be integrated in the final version of LAPS and more learning materials may be developed based on the result of needs assessment. For this development phase, we will

- Conduct an orientation on the goals of the project and the specific learning needs that should be addressed in material development, and on how the material development activities may proceed. Participants will include the teacher in-charge and teachers from the target high school.
- Schedule a meeting to brainstorm on topics or skills that may require development of additional LAPS; or how the needs of students may be addressed in the developed learning materials. Participants will be faculty of Math & Stat Dept., graduate students and invited teachers from the target barangay high school.
- Prepare plan of activities to include review and critiquing of developed materials, validation and pilot testing, and lesson study schedules in case of additional materials to be developed.
- Conduct a training on representation approach, scaffolding techniques, and other topics to address teachers' needs in relation to material development. The resource persons will be the faculty of Math & Stat Dept. while the participants are graduate students and invited teachers from the target barangay high school.

4. Validation, pilot-testing, and refinement of developed LAPS

The PhD and MST Mathematics graduate students have already developed Learning Activity Pages (LAPs) in collaboration with DMS faculty through a series of lesson study. There are two types of LAPs currently developed based on purpose: 1) to improve learning of specific mathematics content; 2) to enhance mathematics skills or literacy (such as number sense, measurement, pattern recognition). The developed materials are not grade-level specific, but the presentation is anchored on what the developers



CAPSULE PROPOSAL FOR EXTENSION

believe the target students can do, slowly increasing in cognitive demand and in a manner that would engage students in the task. The scaffolding of tasks considered the Zone of Proximal Development for students to persist and remain engaged to complete the tasks.

The existing developed materials will be validated and pilot-tested to ensure that students can learn the materials as projected.

- The validation will involve faculty of Math and Stat Dept. who will evaluate the activities, assessments and content presentation of the materials. It will also involve some teachers from barangay high schools who will provide valuable feedback as to the appropriateness, usability, and perceived efficiency of the developed materials based on their experience with the students.
- The pilot-testing of developed materials will involve high school students, preferably from barangay high schools who will provide valuable feedback whether the developed materials can achieve the engagement and learning outcomes expected from the use of materials.
- The refinement will integrate all significant feedback gathered during needs assessment, validation and pilot testing to ensure that the materials specifically suit the academic requirements and capabilities of students in barangay high and produce the desired learning outcomes. The refinement will involve graduate student teachers who developed the existing materials and the invited teachers from barangay high schools.
- The development of additional learning materials will be needs-based. The primary consideration in the developing additional materials will be the mathematics concepts or skills needed to improve understanding of math concepts and overall numerical literacy among students at barangay high schools.

5. Packaging and reproduction of LAPs

- The final layout and graphic design will consider cost-efficiency, readability and usability. Cognitive overload was considered during material development so that each page (back-to-back) of learning activity develops only one math concept or skill. An expert will be hired to efficiently lay out the materials.
- The printing and packaging of final version of LAPs will target durability so that the materials can be used and reused by students. The initial lay-out and packaging design is patterned from Science Research Associates (SRA) reading laboratory kits.



CAPSULE PROPOSAL FOR EXTENSION

- Reproduction of LAPs for implementation will be limited to target extension beneficiaries. The result of implementation will provide feedback on the effectiveness of the learning materials. A better version will be packaged after this project for patenting, for subsequent extension activities and possible commercialization.

Implementation Phase:

This project will be implemented at Salvacion High School at Salvacion, Matalam, Cotabato. This barangay school is an annex to Kibia High School. As an annex school, it has a teacher-in-charge (TIC) but its resources and teachers come from the mother school. The time the proposed activity will be implemented in school will mostly be under the decision of the TIC who will be using the material resources to engage in academic tasks during class periods where no teacher is available to handle. During the implementation, the project will

- provide ongoing support to the TIC in addressing challenges.
- provide support to teachers in facilitating and addressing concerns during students' engagement with the materials
- conduct immediate evaluation of students' outputs (answers in the LAPs) as basis of continuing learning support to the students and for lesson refinement
- monitor implementation to ensure that the activities are proceeding as planned and attaining desired outputs.

Evaluation Phase:

- The effectiveness of the extension project in improving student learning outcomes will be measured through an experimental study where the pretest and posttest scores of the students in mathematics achievement test and numerical literacy test will be compared. Students' answers in the LAPs will also be used as indicator of improvement in the desired learning outcomes.
- To determine effectiveness of the developed instructional materials in fostering lifelong learning skills, the observation notes and/or interview with teachers will be used to describe improvement in students' problem solving, persistence in doing mathematical tasks and independent study.



CAPSULE PROPOSAL FOR EXTENSION

- The impact of the extension project on school operation and performance will be based on teacher-in-charge narratives on how the learning materials addressed some challenges such as mitigating teacher scarcity and noted achievements of the school that may be attributed to the project.
- Feedback will be gathered from students on their experiences using the instructional materials for independent study of mathematics. This can be done through interviews or focus group discussions while the project is still going on as basis for improving project implementation and after the project as summative evaluation

5. Target Partner-Beneficiaries (Who are the clientele and what are the expected outcomes of the intervention on their KSA/P)

The target beneficiaries of this project are students and teachers in a barangay high school, specifically Salvacion High School Annex at Salvacion, Matalam, Cotabato. The intervention is expected to enhance mathematics learning outcomes and literacy among barangay high school students, develop lifelong learning skills.

6. Potential Impact

(Briefly discuss the potential impact of the intervention in any of the following: socio-economic wellbeing of the clientele, peace and order situation in the area, and/or environmental impact).

- Improved quality of education in barangay high schools
- Improved access to quality education in remote areas.

7. Estimated Budget

PS	MOOE	Partner/agency counterpart	TOTAL
10,000	40,000		50,000

8. Literature Cited

- De las Peñas M.L.A., & Bautista, D.M (2008). Understanding and developing proofs with the aid of technology. *Electronic Journal of Mathematics and Technology*, 2(3), 261-273.
- Gutierrez, J., & Bilefsky, D. (2021). With schools closed, Covid-19 deepens a Philippine education crisis. Retrieved October 19, 2021, from <https://www.nytimes.com/2021/09/13/world/asia/philippines-students-remote-covid.html>
- Sheldon, C. (2013). *Developing conceptual and procedural knowledge in addition of signed integers through self-instructional worked examples*. *Learning and Instruction*, 29,176-190.
- Taka D., Taka A., & Budinski N. 2010. On visualization problems using the GeoGebra and Scientific Workplace packages. *International Journal for Technology in Mathematics Education* 17(4): 191–196.



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9. BRIEF PROFILE OF PROPONENT/S (Add tables if necessary)			
1. Name:	Leorence C. Tandog		
2. Education			
Name & Address of Educational Establishment	Degrees Obtained & Area of Specialization	Month / Year	
		From	To
UP Diliman	PhD Science Ed - Math	June 1993	June 1997
Notre Dame University	MA in Math Education	June 1987	March 1992
Notre Dame University	BS Mathematics	June 1983	March 1987
3. Work Experience/s			
Position Title	Company	Inclusive Dates (mm/dd/yyyy)	
		From	To
Mathematics Instructor/Professor	University of Southern Mindanao	1988	present
4. Publications and Research Experience/s			
<p>Usman, B., Usman, M., & Tandog, L. (2023). The Potential of Self-learning modules to develop mathematical representations and connections in distance learning. <i>International Journal of Advance Research and Innovative Ideas in Education</i>, 9(4)</p> <p>Tandog, TK. & Tandog, L. (2023). Farming amidst climate change: The contextual vulnerability of farmers in Cotabato, Philippines. <i>Journal of Agricultural Research, Extension and Technology</i> 5(1)</p> <p>Sharifi A., Simangan, D., ..., Tandog, L., & Islam, M. (2021). Climate-induced Stressors to Peace: A Review of Recent Literature. <i>Environmental Research Letters</i>, 16</p> <p>Elipane, L. & Tandog L. (2014). Introducing Lesson Study in Southern Philippines: Foreseen Challenges in 2014 SEAMEO-RECSAM: Empowering the Future Generation through Mathematics Education, ISBN 978-967-930-069-9</p> <p>Tandog, L. (2010) Bridging the Gap: Experimental Study on Remediating the Competencies in Math for Pre-service Teachers. <i>The Mindanawan Journal of Mathematics</i> Vol. 3</p>			
5. Research/Extension Project Grants (if any)			



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Understandings of Conflict Dynamics and Peace Initiatives Among Local Leaders and Determinants of their Support to the Bangsamoro Basic Law. Funded by AusAid through The Asia Foundation.

Experimental Studies on Remediating the Competencies in Math for Pre-service Teachers. Funded by USM Research and Extension

Evaluation of Climate Change Vulnerabilities, Adaptation Strategies of Farmers of Farmers and their Effects on Farm Labor and Environment funded by CHED-DARE Project.

LGU Citizen Satisfaction Index 2019 funded by DILG



CAPSULE PROPOSAL FOR EXTENSION

Training Title

Empowering Educators: Crafting Learning Materials and Design Implementing Design-Based Action Research

Rationale

Barangay high schools were established to provide wider access to secondary education, especially for students in remote areas. However, these schools face challenges such as teacher shortages, lack of resources, and low student performance in mathematics. To address these issues, there is a need for effective learning materials that support independent study.

Reports have shown that barangay high schools struggle with instructional quality due to limited qualified teachers and learning resources. The situation worsened during the COVID-19 pandemic, highlighting the need for self-directed learning tools. Research confirms that well-designed self-instructional materials improve student learning, particularly in mathematics. A recent project using representation approach-based learning materials showed positive results, improving student understanding and engagement.

Without proper intervention, students in barangay high schools will continue to struggle with mathematics, limiting their academic and future career opportunities. Teacher shortages and learning gaps may further widen educational inequality, leaving students at a disadvantage compared to their peers in better-equipped schools.

This project aims to implement and validate representation approach-based learning materials to help students learn mathematics independently. By providing structured self-instructional lessons, students can develop essential math skills even in the absence of a teacher. These materials will not only improve learning outcomes but also encourage problem-solving, critical thinking, and self-discipline—key skills for lifelong learning. Additionally, strengthening independent learning resources will enhance the quality of education in barangay high schools, helping to elevate their credibility and provide more equitable opportunities for students in remote communities.

Objectives

Upon completion of this training program, participants will be able to:

1. Strengthen math teachers' capability to develop representation-based self-instructional materials.
2. Engage teachers in collaborative work of developing research lessons and Learning Activity Pages (LAPs).
3. Validate, pilot-test, and refine LAPs to efficiently facilitate independent learning of mathematics concepts and skills.
4. Enhance mathematics performance and numerical literacy among barangay high school students through implementation of LAPs

Participants

USM Extension implementers, graduate students and invited teachers from the target barangay high school

Venue

GSHall, USM

Date of Conduct

May 30 – 31, 2025

Methodology

The training methods will include:

- Lectures and Presentations
Use clear, engaging presentations with real-life examples.
Provide digital and printed handouts
- Hands-on Workshops
Guide participants in creating instructional materials and drafting action research proposals.
- Group Discussions
Encourage sharing of ideas and best practices.



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Effectiveness of the training will be evaluated through:

- Post-Training Survey
Participants will complete a survey using the ESO enrolled forms (Resource Person Evaluation, Overall training evaluation).
- Output Evaluation
Assess the quality of instructional materials created during the workshop
Review draft action research proposals

Training Management Staff			
Resource Speaker 1	Ms. Aurea Puyos	Topic	Lecture 1: Action Research
Resource Speaker 2	Dr. Ian June Garces	Topic	Lecture 2: Writing Good Math Problems
Resource Speaker 3	Dr. Debbie Marie Verzosa	Topic	Lecture 3: Development of Representation Approach – Learning Materials
Resource Speaker 4	1. Dr. Lorence Tandog 2. Dr. Anna Jean Garcia	Topic	Lecture 4: Design – based Research

Estimated Budgetary Requirement		
Particular	Quantity/Unit	Amount
A. Personal Services	N/A	
B. Operation and Maintenance		
Supplies and Materials	Training kits/Printed modules - Ballpens - Papers - Markers	5,000
Meals and Snacks	280x75(70x4 snacks) 140x165 (70x2meals)	21,000 23,100
Total		49,100

Proposed Flow of Activity		
Time	Activity	Person Responsible
May 30, 2025 9:00AM – 10:30AM	Lecture 1: Action Research	Resource Persons Ms. Aurea Puyos
10:30AM – 12:00 PM	Lecture 2: Writing Good Math Problems	Dr. Ian June Garces
1:00PM – 2:30PM	Lecture 3: Development of Representation Approach – Learning Materials	Dr. Debbie Marie Verzosa
2:30PM – 5:00PM	Workshop	Facilitators Lorence Tandog, Philip Lester Benjamin, Sandra Nanding, Anna Jean Garcia, Daryl Mae Mamon, MST/PhD Students



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March 31, 2025 8:30AM – 10:00AM 10:00AM – 12:00PM 1:00PM – 4:00PM	Lecture 4: Design – based Research Workshop Group presentation and feedbacking	Resource Persons Dr. Leorence Tandog and Ms. Anna Jean Garcia Facilitators Jupiter Pilongo, Daryl Mae Mamon, Lawton Yabes, Roel Valenton, Rowel Madio, Leonard Paleta, MST/PhD Students
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