OUTCOMES OF ELECTRONICS PRODUCTS ASSEMBLY AND SERVICING TRAINING FOR PHILIPPINE ARMY PERSONNEL

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***ABSTRACT**: State-university extension programs require evidence that technical training is transferred to work and contributes to organizational performance, not only evidence of attendance or course completion. This study evaluated the sustained outcomes of a 120-hour Electronics Products Assembly and Servicing (EPAS) training program delivered in 2019 to personnel of the Philippine Army 4th Signal Battalion. A retrospective convergent mixed-methods outcome evaluation was conducted in 2022. Ten of the 17 training completers answered a competency-aligned survey; four of these respondents and three immediate supervisors participated in interviews. Survey data were summarized using frequencies, percentages, means and 95% Wilson intervals for key binary outcomes. Interview responses were organized into theory-of-change domains and integrated with quantitative findings. Mean confidence ratings across four EPAS competency domains ranged from 4.3 to 4.5 on a five-point scale. Nine of ten respondents reported using EPAS skills at work, seven reported promotion after the training, five reported additional income, and four reported EPAS NC II certification. Trainees described household and workplace repair, cost avoidance, faster troubleshooting and greater confidence. Supervisors described improved responsiveness, reliability and support to unit operations. Participants recommended more hands-on practice, updated content and modern diagnostic facilities. The evidence suggests sustained skill use and plausible contributions to occupational and organizational outcomes. However, the small self-selected sample, retrospective self-report, absence of baseline and comparison data, and lack of objective performance records preclude causal claims. Future evaluations should prospectively track practical competence, certification, repair turnaround time, equipment downtime and cost savings*.

Keywords: electronics servicing; extension program; Philippine Army; training transfer; theory of change; mixed-methods evaluation

INTRODUCTION

Extension is a core function of Philippine higher education institutions and is expected to translate university knowledge and technical expertise into socially responsive programs [1]. For technical and vocational education and training (TVET), this function is especially important because equipment, production systems and occupational standards change rapidly. Philippine TVET therefore faces a continuing requirement to keep curricula, facilities and trainer capability aligned with Industry 4.0 and emerging workplace practices [2]. In electronics servicing, the national competency framework covers the preparation of tools and work areas, diagnosis of faults, maintenance and repair, reassembly, testing and related service functions [3]. These competencies have direct relevance to military signal and engineering units that maintain electronic, communication and information and communications technology equipment.

Evidence that a course was delivered, however, is not equivalent to evidence that learning was transferred. National TVET reviews have repeatedly emphasized the need to connect training provision with certification, occupational use and labor-market or workplace outcomes [4]. Training-transfer research likewise shows that post-training performance depends on more than what occurs during instruction. Skill retention and application are influenced by trainee motivation, similarity between training and work tasks, opportunity to perform, supervisor support and the broader transfer climate [5-8]. Consequently, an evaluation that reports only attendance, satisfaction or immediate confidence provides an incomplete basis for deciding whether a technical extension program should be continued, redesigned or scaled.

This distinction is critical in the present program. In 2019, the College of Technology of the University of Science and Technology of Southern Philippines conducted 120 hours of EPAS training for 25 personnel of the 4th Signal Battalion, 4th Infantry "Diamond" Division. The program was intended to strengthen diagnostic, maintenance and repair capability in support of the battalion's technical and engineering services. Seventeen personnel completed the course. Yet the available program records did not establish whether the competencies were sustained and used after participants returned to their assignments, whether trainees pursued national certification, or whether the course plausibly contributed to personal, occupational and organizational outcomes.

The unresolved problem was therefore not whether the training had been conducted, but whether its intended pathway from instruction to workplace use and organizational contribution could be supported by evidence. This problem is practically important because delayed or weakly designed evaluations can overstate benefits. Confidence is an affective and self-perceived indicator and may not correspond closely to objectively demonstrated knowledge or performance [9]. Promotions, additional income and organizational improvements may also be influenced by assignment decisions, prior experience, rank, staffing and other concurrent changes. A defensible evaluation must therefore distinguish direct observations from perceived associations and causal effects.

The study used a theory-of-change perspective, in which training activities are expected to produce immediate outputs, intermediate outcomes and longer-term effects [10]. Because no baseline or comparison group was available, the evaluation was also informed by contribution analysis: the purpose was to examine whether the observed pattern of evidence was consistent with the proposed results chain while

explicitly considering alternative explanations [11]. The resulting logic linked EPAS instruction and hands-on practice with perceived competency and certification, subsequent use of skills in work and personal settings, and possible occupational and organizational benefits. The analysis does not treat this sequence as proof of causality; rather, it provides a structured basis for assessing plausible contribution.

Accordingly, the study addressed four questions: (1) What were the participation, completion and certification outcomes of the program? (2) What levels of confidence and workplace application did respondents report for the EPAS competencies? (3) What personal and professional changes did trainees associate with the training? and (4) How did immediate supervisors describe changes in technical and engineering services, and what improvements did participants recommend for future training?

MATERIALS AND METHODS

Design and setting

The study used a retrospective convergent mixed-methods outcome-evaluation design rather than a causal impact design. Quantitative survey data and qualitative interview accounts were collected during the same evaluation period, analyzed separately and then merged to determine areas of convergence, complementarity and uncertainty [12,13]. This design was appropriate because the evaluation required numerical descriptions of reported outcomes as well as contextual explanations of how skills were used in a specialized military workplace. The evaluation was conducted in 2022 at Camp Evangelista, Patag, Cagayan de Oro City, approximately three years after the May-July 2019 training. The interval allowed assessment of sustained use, but it also increased the possibility of recall error and personnel attrition.

Participants and sampling

The original training cohort consisted of 25 Philippine Army personnel, of whom 17 completed the 120-hour program. A census of all completers was intended. Ten completers who could be contacted through the 4th Signal Battalion responded to the survey, corresponding to 58.8% of completers and 40.0% of the original cohort. Four survey respondents were interviewed to elaborate their experiences. Three immediate supervisors who were familiar with the trainees' current assignments and post-training performance were also interviewed. Personnel who had been reassigned outside Cagayan de Oro City could not be reached. The achieved sample was therefore an availability-based subset and may have differed from nonrespondents in certification, promotion, assignment or use of EPAS skills.

Instrument and data collection

The researcher-developed questionnaire was mapped to four competency areas specified in the training design: (1) preparation of units, tools, equipment and workplace for maintenance or repair; (2) diagnosis of faults in electronically controlled domestic appliances; (3) maintenance, repair, reassembly and testing of appliances and audio-video or domestic electronic systems; and (4) development of an EPAS product or service. Confidence was rated from 1 (very unconfident) to 5 (very confident).

Table 1. Participant flow and achieved evaluation sample

Stage	n	% of prior stage
Personnel enrolled in training	25	-
Personnel who completed 120 hours	17	68.0
Completers who answered survey	10	58.8
Survey respondents interviewed	4	40.0
Immediate supervisors interviewed	3	-

The questionnaire also asked whether respondents had obtained EPAS NC II certification, earned additional income, experienced promotion after training and used EPAS skills in the workplace. Trainers and the Extension Unit Director reviewed the instrument for face and content relevance. Given the achieved sample of ten, no internal-consistency or factor analysis was attempted; the four items were reported separately and should not be interpreted as a validated psychometric scale.

Survey forms were distributed through Google Forms with the assistance of battalion officers. Semi-structured interviews were conducted face-to-face with four trainees and three immediate supervisors. Trainee questions focused on personal and professional changes, examples of skill application and perceived negative or unintended effects. Supervisor questions focused on changes in repair and maintenance services, responsiveness, reliability and contribution to unit functions. Interviews also elicited recommendations for program improvement.

Analysis and integration

Categorical survey variables were summarized using counts and percentages. Competency confidence was summarized using the observed distribution, mean and sample standard deviation. For the four binary outcomes, 95% Wilson score intervals were calculated to show the considerable uncertainty associated with n=10 [14]. These intervals describe precision and were not used for population hypothesis testing.

Interview responses were organized using directed content analysis [15]. Initial categories followed the theory-of-change domains: competency development, workplace application, personal benefit, occupational change, organizational contribution and recommendations. The authors retained concrete examples, compared trainee and supervisor accounts and noted claims that could not be independently verified. Quantitative and qualitative findings were integrated through narrative weaving and a joint interpretation of whether the sources converged. Because only four trainees were interviewed and no formal saturation assessment was documented, qualitative findings are presented as illustrative patterns rather than exhaustive themes.

Ethics

All participants received written information about the purpose, procedures, voluntary nature, possible risks and benefits, confidentiality limits and right to withdraw. Written informed consent was obtained before participation. Identifying details were minimized in reporting.

RESULTS

Participation, completion and certification

Seventeen of the 25 enrolled personnel completed the course, giving a completion rate of 68.0%. Ten completers participated in the survey. Four of these ten respondents (40.0%; 95% CI: 16.8-68.7) reported that they had obtained EPAS NC II certification. Participants who did not proceed to assessment cited competing work and military-training schedules, non-enrollment in the assessment and prioritization of other military requirements. The result is best interpreted as limited certification uptake among respondents, not as evidence that the remaining trainees lacked competence. Certification requires a separate assessment decision and opportunity in addition to course participation.

Confidence in EPAS competency areas

Confidence ratings were consistently favorable (Table 2). Nine of ten respondents were confident or very confident in preparing the work area, maintaining and testing systems, and developing a product or service; all ten were confident or very confident in fault diagnosis. Item means ranged narrowly from 4.3 to 4.5. The highest mean was reported for diagnosing faults in electronically controlled domestic appliances *(M=4.5, SD=0.53)*, while maintenance, repair, reassembly and testing had the lowest, although still favorable, mean *(M=4.3, SD=0.67)*. The presence of one unsure response in three domains suggests that the training did not produce uniform perceived mastery across all completers.

Table 2. Reported confidence in EPAS competency areas (n=10)

Competency area	Unsure n (%)	Confident n (%)	Very confident n (%)	Mean (SD)
Prepare tools, equipment and work area	1 (10)	4 (40)	5 (50)	4.4 (0.70)
Diagnose faults	0 (0)	5 (50)	5 (50)	4.5 (0.53)
Maintain, repair, reassemble and test	1 (10)	5 (50)	4 (40)	4.3 (0.67)
Develop an EPAS product or service	1 (10)	4 (40)	5 (50)	4.4 (0.70)

Scale: 1=very unconfident, 2=unconfident, 3=unsure, 4=confident and 5=very confident. No respondent selected very unconfident or unconfident.

Workplace use and reported occupational outcomes

Workplace use was the most frequently reported outcome: nine of ten respondents *(90.0%; 95% CI: 59.6-98.2)* stated that they used EPAS skills in their assignments (Table 3). Seven respondents *(70.0%; 95% CI: 39.7-89.2)* reported promotion after the training, and five *(50.0%; 95% CI: 23.7-76.3)* reported earning additional income. The wide intervals show that the cohort-level percentages remain imprecise and should not be generalized beyond the respondents.

How trainees used the skills

Interview accounts explained what "use" meant in practice. Respondents described troubleshooting and repairing rice cookers, televisions, electric fans, flat irons and other household appliances. At work, they reported maintaining electronic equipment, radio batteries, power supplies, desktops and laptops.

Table 3. Outcomes reported by survey respondents (n=10)

Outcome	n	%	95% CI
Obtained EPAS NC II certification	4	40	16.8-68.7
Earned additional income	5	50	23.7-76.3
Reported promotion after training	7	70	39.7-89.2
Used EPAS skills in the workplace	9	90	59.6-98.2

CI = 95% Wilson score interval. "Promotion after training" is a temporal association and should not be interpreted as a verified causal effect of the program.

One respondent described a change from routinely discarding defective equipment to diagnosing and attempting repair before replacement. These examples indicate transfer in the form of generalization of learned procedures to equipment encountered after training.

The reported benefits were not limited to direct income. Some personnel repaired appliances for family members or neighbors without charging a fee, consistent with their understanding of public service. Others emphasized avoiding household repair costs, reducing replacement expenditure and becoming able to assist when the unit's designated repair personnel were unavailable. Thus, the original indicator of "additional income" captured only one possible economic benefit and did not measure cost avoidance, unpaid service or reduced equipment downtime.

Trainees also described greater confidence and faster response when facing repair and maintenance problems. One participant reported reassignment from office work to an electronics-related platoon after the training. These accounts are consistent with occupational utilization, but the data do not establish that training alone caused reassignment or promotion. Rank progression, vacancies, command decisions, prior experience and other military qualifications were not measured.

Supervisor perceptions and improvement priorities

The three supervisors described the trained personnel as more responsive and reliable in diagnosing, troubleshooting and maintaining electronic and ICT equipment. They linked the acquired skills to assignments in engineering, electronics and signal functions and reported that the trainees contributed to services provided to other Philippine Army units. The principal convergence across data sources was therefore between the 90% self-reported workplace-use rate and supervisor accounts of faster or more confident technical response. Supervisor testimony strengthened the plausibility of transfer, although no repair logs, turnaround-time records, equipment-availability data or cost records were available to quantify the organizational change.

Participants and supervisors consistently recommended more hands-on practice, better alignment of lessons with actual assignments, removal of obsolete content, and upgrading of tools, diagnostic equipment and facilities. These recommendations reveal an important boundary condition: skills transfer depends not only on whether trainees learned procedures, but also on whether training content and equipment resemble the technologies they encounter at work.

DISCUSSION

Evidence of sustained transfer

The strongest finding is the reported continuity of skill use approximately three years after training. Transfer literature defines successful transfer as both generalization of learning to the workplace and maintenance of that application over time [5,16]. The high workplace-use proportion, concrete examples of troubleshooting and repair, and corroborating supervisor accounts form a coherent pattern that is more informative than confidence ratings alone. The cases suggest that the program was relevant to assignments in signal, electronics, computer hardware and maintenance functions.

Role alignment and opportunity to perform offer a plausible explanation for this pattern. Meta-analytic evidence indicates that transfer is more likely when the work environment provides cues, resources, supervisor support and repeated opportunities to use trained behavior [6-8]. In this study, personnel assigned to electronics, ICT and signal-related functions encountered equipment requiring diagnosis and maintenance. Immediate supervisors also appeared to recognize and deploy the acquired capability. These conditions may have reinforced retention. Conversely, the one unsure response in several competency areas may reflect uneven opportunities to practice particular tasks or differences in assignment exposure.

The favorable confidence means should nevertheless be interpreted cautiously. Self-assessments can reflect motivation, satisfaction and perceived readiness as much as objective knowledge or competence [9]. Reviews of training-transfer measurement likewise show that self-reported frequency, quality of application and performance improvement are distinct constructs and can produce different conclusions [16]. The study did not include a practical performance test, assessor rating or pre-training score. It can therefore conclude that respondents felt confident and reported use, not that all respondents met a verified mastery standard.

Occupational, economic and organizational meaning

The reported outcomes extend beyond the original expectation of income generation. Half of respondents reported additional income, but interviews showed that some trainees deliberately provided repair services without charge. Cost avoidance through repairing rather than replacing household or unit equipment may have been equally or more relevant. A future economic evaluation should therefore measure the monetary value of avoided external repair fees, prevented replacement, reduced equipment downtime and unpaid community service rather than relying on an income yes/no item.

The promotion finding also requires a more disciplined interpretation. Seven respondents reported promotion after the course, and some supervisors associated certification and skill growth with advancement. However, no personnel records, comparison group or model of promotion determinants was available. The appropriate conclusion is that training may have strengthened participants' technical profile and perceived readiness for electronics-related responsibilities, while causation remains unverified. Contribution analysis is useful in such circumstances because it asks whether a program is one credible factor within a broader causal package rather than the sole cause [11].

At the organizational level, supervisor reports of quicker diagnosis, greater reliability and improved service to other units are practically significant. They suggest that individual capability may have translated into unit-level responsiveness. Yet the study measured perception rather than operational performance. Future indicators should include number and type of repairs completed, first-time repair rate, turnaround time, equipment downtime, external service expenditure, spare-parts cost and mission-critical equipment availability. Linking these records to trainee assignment would allow a stronger test of the theory-of-change pathway.

Certification gap and program redesign

Only four respondents reported EPAS NC II certification. This result should not be treated as a failure rate because course completion and national assessment are separate processes. Respondents identified schedule conflicts, non-enrollment and competing military training as barriers. The program can address this implementation gap by integrating assessment orientation, eligibility checking, scheduling and referral into the extension plan. Evaluation of future cohorts should distinguish those who were eligible, registered, assessed, certified and reassessed, with reasons for attrition at each stage.

The request for more hands-on training and updated equipment is consistent with evidence that practice fidelity and work-environment similarity facilitate transfer [7,8]. It also reflects the rapid obsolescence risk in electronics and digital systems. Philippine skills-development analyses stress the need to modernize TVET curricula, laboratories and trainer capability as Industry 4.0 changes occupational tasks [2,18-20]. A revised course should begin with a training-needs analysis of the battalion's current equipment and recurring faults, then allocate most instructional time to supervised diagnosis, repair, testing and documentation using comparable devices. Refresher modules can target new power electronics, ICT hardware, embedded systems and safe handling of contemporary components where these are relevant to unit requirements.

Program follow-up should also become part of the intervention rather than an afterthought. Organizational studies indicate that systematic evaluation is associated with greater attention to transfer and accountability [17]. A practical schedule would include baseline assessment, immediate post-test, six-month transfer review and 12-month organizational-outcome review. The six-month review can identify barriers while trainees and supervisors can still act on them; the 12-month review can assess persistence and operational benefit. Local culture and service norms should be incorporated because they influence how trainees understand benefits, including the preference for unpaid assistance rather than personal income [21].

Limitations

The study has several limitations that materially constrain interpretation. First, only ten of 17 completers responded. Reassigned personnel may have had different outcomes, and the achieved sample was too small for reliable subgroup analysis or multivariable modeling. Second, the three-year recall period may have affected the accuracy of certification, income, promotion and use reports. Third, the survey was researcher-developed and received face and content review but no psychometric validation. Fourth, confidence and

outcome indicators were self-reported; supervisor interviews offered partial triangulation but were also subjective. Fifth, the absence of baseline competence, a comparison group and objective administrative or maintenance records means that causal impact cannot be estimated. Sixth, only four trainees were interviewed and formal thematic saturation was not established. Finally, the evaluation did not measure training fidelity, amount of hands-on practice, quality of equipment, prior electronics experience or frequency of opportunities to perform, all of which could explain differences in transfer.

These limitations do not make the evaluation uninformative. They define the level of claim the evidence can support. The study provides a bounded account of perceived sustained outcomes and a credible agenda for program improvement; it does not provide a population estimate for all trainees or proof that training caused promotion, income or organizational change.

CONCLUSION

The retrospective mixed-methods evidence suggests that the 2019 EPAS training made a plausible contribution to sustained electronics-servicing capability among the respondents. Confidence was high across four competency domains, nine of ten respondents reported workplace use, and interviews documented household and organizational applications. Supervisor accounts converged with reports of improved responsiveness and reliability. The program therefore appears relevant to the technical functions of the 4th Signal Battalion.

The evidence is not sufficient to claim causal impact. Small-sample nonresponse, retrospective self-report, lack of baseline and comparison data, and absence of objective performance records require cautious interpretation. The principal publication-worthy contribution of the study is the demonstration that extension-program evaluation should move beyond participation counts to examine sustained transfer, work-context conditions, certification pathways and organizational performance. Future EPAS programs should use current equipment, increase authentic hands-on practice, align content with unit needs, support certification scheduling and implement prospective six- and 12-month evaluation using both practical assessments and maintenance records.

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DATA AVAILABILITY

De-identified data may be requested from the corresponding author, subject to University and Philippine Army approvals and applicable confidentiality requirements.

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