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# Learning Motivation as a Mediator of Curriculum Relevance and Seedling Understanding on Practical Readiness in Forestry Education

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**ABSTRACT**

The The challenge for forestry education is both the transfer of technical knowledge and whether students are adequately prepared to practice in the field. We examined the relationships among the four variables: Seedling Understanding (SU), Curriculum Relevance (CR), Learning Motivation (LM) and Practical Readiness (PR) among forestry undergraduates. We employed a quantitative, explanatory design based on data from 54 students taking a Seedling Techniques course. PLS-SEM was used for measuring and structural models testing. Results show that curriculum relevance ($\beta = 0.487$) and seedling understanding ($\beta = 0.349$) significantly increase learning motivation, which strongly predicts practical readiness ($\beta = 0.627$; $R^2 = 0.798$). These findings highlight the importance of motivation-driven curriculum design to enhance practice-ready forestry graduates. These results imply that technical understanding and curriculum design are necessary but only lead to readiness because of their motivational impact on students use or integration of those skills; using lessons learned to motivate student engagement and further application of practical knowledge. This integration of cognitive, pedagogical, and motivational dimensions into a single empirical model is a unique aspect of the study and extends the motivational theory currently present in the literature to include forestry education. In practical terms, the results provide some suggestions on the development of curricula and teaching strategies that incorporate relevance, autonomy and practice to develop competence and preparedness.

Keywords: Forestry Education, Learning Motivation, Practical Readiness, PLS-SEM

**ABSTRAK**

Tantangan bagi pendidikan kehutanan adalah baik transfer pengetahuan teknis maupun apakah mahasiswa telah dipersiapkan dengan baik untuk praktik di lapangan. Kami menelaah hubungan antara empat variabel: Pemahaman Bibit (SU), Relevansi Kurikulum (CR), Motivasi Belajar (LM) dan Kesiapan Praktik (PR) pada mahasiswa kehutanan. Kami menggunakan desain kuantitatif eksplanatori berdasarkan data dari 54 mahasiswa yang mengikuti mata kuliah Teknik Bibit. PLS-SEM digunakan untuk pengukuran dan pengujian model struktural. Hasil menunjukkan bahwa relevansi kurikulum ($\beta = 0{,}487$) dan pemahaman bibit ($\beta = 0{,}349$) secara signifikan meningkatkan motivasi belajar, yang secara kuat memprediksi kesiapan praktik ($\beta = 0{,}627$; $R^2 = 0{,}798$). Temuan ini menekankan pentingnya desain kurikulum yang didorong motivasi untuk meningkatkan lulusan kehutanan yang siap praktik. Hasil-hasil ini menyiratkan bahwa pemahaman teknis dan desain kurikulum diperlukan tetapi hanya menghasilkan kesiapan karena dampak motivasionalnya pada penggunaan atau integrasi keterampilan oleh siswa; menggunakan pelajaran yang dipelajari untuk memotivasi keterlibatan siswa dan penerapan lebih lanjut pengetahuan praktis. Integrasi dimensi kognitif, pedagogis, dan motivasional ke dalam satu model empiris adalah aspek unik dari penelitian ini dan memperluas teori motivasi yang saat ini ada dalam literatur untuk mencakup pendidikan kehutanan. Secara praktis, hasil-hasil ini memberikan beberapa saran terkait pengembangan kurikulum dan strategi pengajaran yang menggabungkan relevansi, otonomi, dan praktik untuk mengembangkan kompetensi dan kesiapan.

Kata Kunci: Pendidikan Kehutanan, Motivasi Belajar, Kesiapan Praktis, PLS-SEM

## INTRODUCTION

Serangga Forestry education has long been seen as the basic means of training graduates in a variety of skills necessary for a wide-ranging profession. It is a technical knowledge, but you have to respect the theory-to-practice so that students confront ecological, social and managerial challenges. One of the most important features from regeneration performance point of view is seedling understanding because many forestry products are related to the level of quality in 3 year old plants. It is reported that targeted training regarding seed production and nursery management may contribute to an improvement in student skills and knowledge (Dahliani & Mumpuni, 2023). These baseline skills allow for easier integration into work environments, enhancing confidence and success in hands-on forest management activities.

But mastering content is not enough when nowhere has the curriculum learned how to be academically rigorous and contextually relevant at the same time. Also in the era of climate change, beyond the technical skills, forestry professionals have to develop soft skills (e.g., communication and social cultural understanding) to address multifaceted human–forest interactions. The integration of ecological, practicality and interpersonal competencies are emphasised as being necessary for the effective leadership of

forestry (Hoagland et al. Competency-based curricula narrow the gap between what graduates are expected to know in relation to labor markets or employer demands (Toan et al 2023). In addition, practicum and internship experiences contribute to the level of preparedness by exposing students to authentic simulated environments that will address industry problems (Nguyen et al., 2022).

The psychological dimension, in particular student motivation, is as important. Motivation connects knowledge and performance, so motivation matters for whether students will engage or shy away from difficult tasks. The presence of intrinsic motivation would then make students more resilient in the field and enable them to accept uncertainty (Arif et al., 2024). Self-efficacy—the confidence in one's ability to achieve performance—has been associated with greater professional task readiness (Yuliyanto et al., 2024). In the case of forestry education, adapting with a broad range of foundations "is imperativeay." Such motivating driving forces are necessary in forestry education which poses adaptability and resiliency requirements. There is evidence that self–directed learning environments and supportive pedagogies contribute to the development of motivation and autonomy in fieldwork settings (Tentama et al., 2019).

Notwithstanding these recognitions, the literature still has very serious gaps. Previous research has mainly focused either on technical or ecological aspects and the in-depth associations between psychological, pedagogical and practical in readings readiness for practice are only scantly empirically explored. There are limited studies enunciating comprehensive models that combine seedling understanding (SU), curriculum relevance (CR) and learning motivation (LM) as joint predictors of practical readiness (PR). Of particular interest is the mediating relationship of motivation when connecting knowledge, curriculum and preparedness. Filling this gap is important, because forestry graduates face international challenges such as deforestation, climate change and ecological restoration, where theory must be applicable to practice.

This gap can be filled by examining how SU, CR and LM affect PR empirically in forestry undergraduates. Applying Partial Least Squares Structural Equation Modeling (PLS-SEM), the study offers not only methodological but also substantive implications. Methodologically, it utilizes PLS-SEM to test the measurement and structural model with a small sample size thereby providing strong statistical results. Content-wise, it incorporates psychological (motivation), pedagogical (curriculum relevance) and technical (seedling understanding) aspects into one explanation. Furthermore, it examines whether LM plays a mediating role to the extent that motivation works as a mechanism between knowledge and curriculum design on practical readiness.

Thereby, the study serves to forward theory by integrating cognitive, pedagogical and motivational aspects in forest education. It also has testing implications for curriculum covering, the combined improvement of technical competence, motivations and contexts would promote students' readiness in the field practice. Finally, our study highlights the need for evidence-based practice to increase forestry education's comparative advantage in a changing professional and environmental world. Although previous studies have examined technical competence or curriculum design in forestry education, empirical models integrating technical understanding, curriculum relevance, and learning motivation as joint predictors of practical readiness remain limited, particularly in tropical forestry contexts. This study aims to examine the mediating role of learning motivation in linking seedling understanding and curriculum relevance to practical readiness among forestry students. This study contributes novelty by empirically integrating technical competence, curriculum relevance, and motivational psychology into a single PLS-SEM model within forestry education, a combination rarely examined in tropical forestry contexts.

## Literature Review and Hypotheses Development

*Seedling Understanding (SU)*

Seedlings are a fundamental and intellectual foundation of forestry education, as well propagation is the basis of regeneration, which affects how well students are educated themselves to broader forestry practice. Knowledge of seed biology, production and ecology is not only a scientific but also an educational need in order to excite and prepare the students. Studies have shown that students are more motivated when the information is connected to their professional science-related duties, and the ARCS model (Attention, Relevance, Confidence, Satisfaction) tells us that information must be relevant and engaging in order to maintain attention (Watkins & Poudyal, 2021). In this way, understanding of seedlings generates intrinsic motivation that leads to deeper involvement and self-directed reasoning. Connecting theoretical ecological themes to applicable nursery management, the understanding

of seedlings can serve as a gauge for meaningful learning experiences.

Loosely in correlation with motivation, seedling understandability powerfully supports the actual readiness by transferring technical knowledge, independence as well as flexibility that are needed in forest work. Student trainees who had exposure to seedlings training tend to score higher in technical and feeling skillful, confident and ready (Hendrayana et al., 2025), while participants with higher level of knowledge feel more capable of a smooth progression into their workplace (Yusof et al., 2024). Therefore, it is essential not to see seedlings as just a concept on paper but as a runway connecting inside classroom learning to the outside professional expectation. As a whole, the literature implies a dual pathway: seedling knowledge promotes Learning Motivation (LM) through relevance and meaning, and reinforces Practical Readiness (PR) by laying technical foundation. Accordingly, the following hypotheses are developed: H1: SU has positive effects on LM. H2: Seedling Understanding (SU) has a positive effect on Practical Readiness (PR).

*Curriculum Relevance (CR)*

The curriculum is the 'missing link' between theoretical, classroom-based learning and real-life professional practice in forestry, when knowledge needs to be transformed into an informed-ecological-science-informed-management-practice and societal engagement. When what's being taught does not mirror on-the-job responsibilities, there's potential for the flame to douse; when it does align with their reality, students become driven and passionate and feel ready. Research in other disciplines show that students that see the curriculum as congruent with their future aspirations, they experienced a greater sense of internal motivation (Del-Ben et al., 2019). In forestry education, curriculum that integrates sustainability and have its teaching transformative effect were found to improve students' motivation in learning (Ray et al., 2022). Curriculum relevance therefore is a prescriptive force for students' aspirations and their LM.

Relevance is also realized directly in practical availability. A trainee curriculum which includes more than theory and involves learning by doing, nursery training and live case study applications ensures competence as well as adaptability for the working life in forestry (Durusoy & Öztürk, 2022; Rosenberg & Riddle, 2018). Types of pedagogical organization such as problem-based and contextbased learning additionally promote engagement and persistence (Hutahaean et al., 2022). Relevant curricula that address the human–forest interface, and are designed to be responsive, including technical and social dimensions ensure graduates can perform at such a human–forest interface – relevance being seen as both a mental and physical leaver (Hoagland et al., 2017). As a whole, the literature implies a dual influence of curriculum relevance: promoting LM via contextual content, and strengthening PR through applied practice. From this the following hypothesis is derived: H3) CR positively influences LM. H4: Practical Readiness (PR) will be positively impacted by Curriculum Relevance (CR).

*Learning Motivation (LM)*

Motivation has been recognized for long as a key factor in the determination of successful learning outcomes, probably with even more importance in forest education linking theory to practice. Self-Determination Theory (SDT) posits that autonomy, competence, and relatedness are key aspects of the learning climate that facilitate intrinsic motivation, leading to better engagement and increased persistence compared to extrinsic rewards (Slavin & Lake, 2018). There are the field challenges, and the preparations for those that separate passive knowledge acquisition with active readiness in preparation of someday achieving your significant goal. Empirical studies reported that the models of bridging theory and practice such as teaching factory or experiential-based curriculum, are able to improve student's motivation and readiness for professional tasks (Hidayat et al., 2024; Rambe, 2025). Motivation, therefore serves as the "mediational" process that transforms declarative learning into procedural ability.

This motivational climate is also influenced by learning environments and curriculum content. Students who see the courses as useful for future forestry practices have more motivation, endurance and confidence (Rambe, 2025). Features such as field visit, conservation activities, and nursery work engender the intrinsic interest and professional competence, preparedness was improved (Siti & Setiyaningtiyas, 2024). Together, these findings confirm the strong impact of motivation on student effort, perceived value for studying and self-efficacy in facing fieldwork demands. Thus, teaching and learning strategies characterised by autonomy, relevance and intrinsic involvement are necessary in forestry education to guarantee practical readiness. From these, the following hypothesis is postulated: H5: Learning

Motivation (LM) has a positive effect on Practical Readiness (PR)

*Mediation Role of Learning Motivation*

There is relatively little clear and direct answer that knowledge in the head of a student or even a professional immediately translates into specific types of behavior – for the educational as well as the professional situation, its influence is reasonably always filtered by motivational forsaking learners to involve with experiences. In forestry education, learning motivation (LM) has been gaining importance as an essential bridge for seedling understanding (SU), curriculum relevance (CR) and practical readiness. Even in the presence of appropriate subject knowledge and a well-defined academic curriculum, you will not generate transferred competence unless you have some motivation. For example, students with a high self-efficacy on knowledge of seed biology or nursery management are more likely to actively seek connections between what they know and how it works in the field scenarios while an inherent interest in course content contributes willingness over and above the interests for hands-on activities. There knowledge is the foundation, yet it is motivation that leads students to take understanding and turn it into a skill. Besides, students are more motivated to apply theoretical knowledge toward future profession task if they view the curriculum content as practical-oriented (Huang & Zheng, 2022). Therefore, motivation serves as the mediator which converts curriculum clarity into preparedness.

The empirical evidence supports this view by demonstrating that the impact of both SU and CR is strengthened by motivation. Huang and Yang (2021) concluded that students who demonstrated relatively strong motivation in courses focusing on applied content would be better prepared for practical work. Likewise, Hong et al. (2024) accentuate curricula that integrate knowledge and motivation make the transition from classroom to real world learning easier. When Knowledge is Not Enough Without motivation, knowledge will become redundant and curricula obsolete (Lay, 2019). When motivation is not present, however SU and CR potentially inhibit work competence whereas in the presence of motivation SU and CR may act as facilitators for professional competence. In general, LM describe the relationship between SU and CR with PR, which highlights the nexus of knowledge–context–psychology in forest education. The implication for educators is straightforward: pedagogical approaches that tap motivation -via career practice relevance, autonomy and intrinsically interesting tasks- are required to ensure that forestry students are not just knowledgeable but also genuinely ready to face the practical demands of their profession

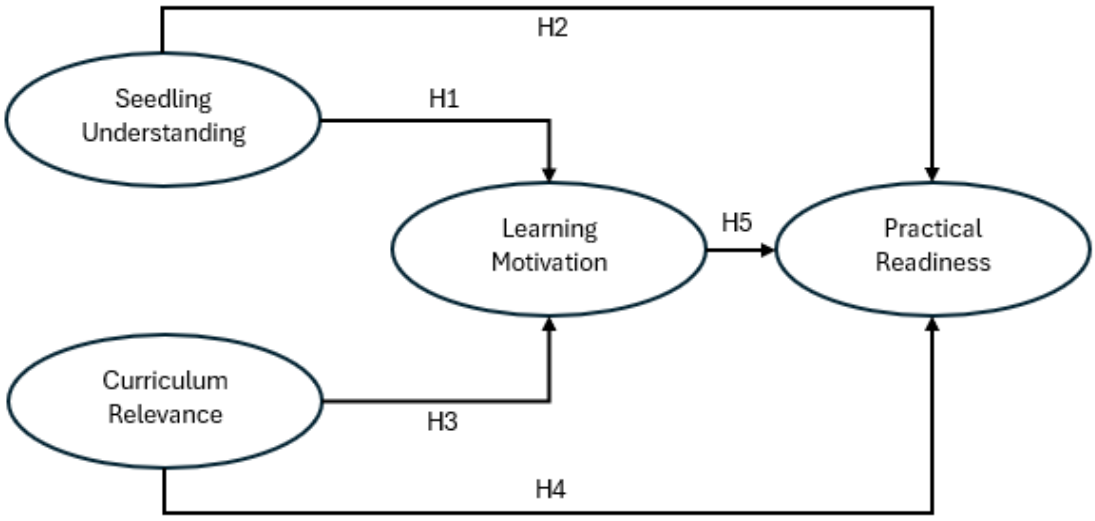


**Figure 1.** Conceptual Framework Linking Seedling Understanding, Curriculum Relevance, Learning Motivation, and Practical Readiness

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The conceptual model developed for this study is presented in Figure 1. An intergrative model of cognitive, pedagogical, and motivational dimensions of learning in forestry education. It relates with Seedling Understanding (SU) and Curriculum Relevance (CR) as the antecedent affecting Learning Motivation (LM) and Practical Readiness (PR). Learning Motivation is also postulated to act as a key mediating factor through which SU and CR exert their influences on Practical Readiness. The arrows denote the path where a causal relationship is hypothesized, and then is tested with Partial Least Squares Structural Equation Modeling (PLS-SEM). This framework depicts the relationships between these three domains (technical knowledge, the design of the curriculum, and psychological drivers) to illustrate ways in which they may impact on how well-prepared forestry students become for practice, thus forming the theoretical basis of the empirical analysis for the study

## MATERIALS AND METHODS

### Research Location

The application of Structural Equation Modelling (PLS-SEM) method this study is an explanatory quantitative research design, especially to measure the effect or relationship between 4 variables Seedling Understanding (SU), Curriculum Relevance (CR), Learning Motivation (LM), and Practical Readiness (PR). We opted for PLS-SEM due to its capabilities to capture complex relationships between several latent constructs in parallel, small sample sizes, and more relaxed distributional assumptions than covariance-based SEM (CB-SEM). This renders it therefore particularly fitting in a forestry education context, where the objective is not only to verify well-established theory but also to expand emerging theoretical frameworks (Hair et al., 2019; Lin et al., 2019). PLS-SEM provides a pragmatic, but nonetheless rigorous approach to identifying how knowledge, curriculum, and motivation coalesce to promote readiness to practice, as it combines measurement and structural modeling in a variance-based framework. PLS-SEM was selected due to the presence of a mediation model, multiple latent constructs, and a relatively small sample size (n = 54), making it suitable for exploratory and theory-building research in forestry education. An example of SU indicator is students' self-reported understanding of seedling physiology and nursery management.

*Sample and Data Collection*

The sample included 54 undergraduate forestry students taking the course of Seedling Techniques at The Forestry Study Program. They were purposively selected due to their direct exposure to nursery practices and seed biology, which made them well suited for this study. The respondents were given the questionnaires during the academic term, which allowed for data to be collected when the respondents were involved with seedling coursework. The survey consisted of demographic data to describe few sociodemographic respondent characteristics, as well as structured items intending to measure the four latent constructs described above. The participation was on a voluntary basis and confidentiality was ensured.

*Measurement Instruments*

The research instrument was organized based on four main constructs: Seedling Understanding (SU), Curriculum Relevance (CR), Learning Motivation (LM), and Practical Readiness (PR) Linking multiple indicators from the literature and using realtime forestry education contexts, each construct was measured.

1. Participants from SU responded to four items measuring their understanding of seedling biology, cultivation, and ecological importance.
2. CR consisted of four items that represented students perception of how well the curriculum blends theory and practice and addresses the needs of the forestry profession.
3. LM was assessed with four items measuring both intrinsic and extrinsic motivation to learn.
4. PR consisted of four items assessing students' perceptions of preparation, confidence, and readiness for manual field skills.

Items were rated on a scale from 1 (strongly disagree) to 5 (strongly agree) using a five-point Likert scale. The reliability and validity of the instrument were checked, where the scales reached the acceptable limits of internal consistency and construct validity.

### Data Analysis

One of the most widely used software packages that has supported PLS-SEM procedures is the JASP software (JASP Team, 2019). Two-stage analysis was carried out as follows:

*Outer Model Evaluation*

Reliability and validity of the measurement model Convergent validity was assessed by item loadings and Average Variance

Extracted (AVE), AVE values above 0.5 indicates a satisfactory convergent validity. Internal consistency was considered adequate with Composite Reliability (CR) greater than 0.7. The Fornell–Larcker criterion and cross-loadings were used to demonstrate the discriminant validity of m and three kinds of empirical distinctness among constructs. The coefficients of Cronbach's alpha and omega were also to ensure the reliability of the instrument.

*Inner Model Evaluation*

To assess the hypothesized relationships among SU, CR, LM, and PR, a structural model was analyzed. These comprised deriving path coefficients (β), coefficients of determination ($R^2$) for endogenous constructs, effect sizes ($f^2$) to assess the contribution of predictors, and predictive relevance ($Q^2$) using blindfolding procedures. We utilized the Goodness-of-Fit (GoF) index as a global indicator of model fit.

We conducted mediation analyses to explore if LM mediates the relationship between SU and PR, as well as CR and PR. Based on the method described by Zhang et al. (2023), a bootstrapping approach was also used to calculate both direct and indirect estimates. To assess mediation, we examined whether the indirect path through LM was significant, whether the direct path decreased in strength, and/or whether it became non-significant.

PLS-SEM, unlike CB-SEM, does not depend on global fit indices per se, but as a supplementary criterion, the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), and the Comparative Fit Index (CFI), were also found to provide additional evidence of model fit (Tzafilkou et al., 2023).

The purpose of this study was therefore to conduct this analytical steps not just to test isolated realationship but rather to account for a structural dynamic encompassing technical/core knowledge, curriculum quality, student, motivation and practice readiness in forestry education

## RESULTS AND DISCUSSION

### Descriptive Statistics

Participants consisted of 54 undergraduate forestry students taking the Seedling Techniques course. These respondents were a targeted population with an active involvement in seedling and nursery practices and consequently, this group was relevant in this study. The data were normally distributed across constructs with no extreme outliers with Z-values above 4, indicating that the data set was appropriate for PLS-SEM analysis. The gender proportion of male and female students, in addition to the academic standing representation within the cohort, provided enough diversity to represent different perceptions for seedling understanding (SU), curriculum relevance (CR), learning motivation (LM), and practical readiness (PR)..

**Table 1.** Descriptive Statistics of Respondents

| Variable | N | % | Notes |
|---|---|---|---|
| Total respondents | 54 | 100 | Forestry undergraduates |
| Course participation | 54 | 100 | Seedling Techniques |

*Measurement Model (Outer Model)*

Initially, the issues of reliability and validity in constructs. Findings confirmed that each indicator loaded significantly on a respective construct (p 0.70, suggest internal consistency. The scores of composite reliability (CR) were higher than the used threshold (0.70) and average variance extracted (AVE) were all high than the threshold (0.50), confirming convergent validity (Kim et al., 2020).

As another way to ascertain discriminant validity, we utilized the Fornell–Larcker criterion, where the square root of AVE for each construct710 substituted its correlations with other constructs. This supports the validity of the measurement model due to the conceptual difference between SU, CR, LM, and PR (Noh et al., 2023)

**Table 2.** Measurement Model Results

| Construct | Indicators | Factor Loadings | CR | AVE | Convergent Validity |
|---|---|---|---|---|---|
| SU | SU1–SU4 | 0.82–1.19 | 0.87 | 0.63 | Supported |
| CR | CR1–CR4 | 0.80–1.27 | 0.85 | 0.58 | Supported |
| LM | LM1–LM4 | 0.72–1.05 | 0.88 | 0.60 | Supported |

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| Construct | Indicators | Factor Loadings | CR | AVE | Convergent Validity |
|---|---|---|---|---|---|
| PR | PR1–PR4 | 1.00–2.03 | 0.89 | 0.62 | Supported |

**Structural Model (Inner Model)**

To test hypothesized relationships, structural model assessment followed. The path coefficients showed that SU and CR have a positive and significant effect on LM with standardized β equal to 0.349 and 0.487 respectively. Lastly, LM had a strong positive impact directly on PR (β = 0.627), and therefore, PR was both direct predictor and mediator for LM. Curriculum-relevance (CR) also retained a strong and direct path to PR (β = 0.470—strongest total effect pathway in the model), reinforcing this dual role of CR.

Model explained a significant amount of variance. $R^2$ for LM was 0.619 suggesting that SU and CR together explained almost 62% of the variance in student motivation. For PR, the model achieved a 79.8% of the explained variance ($R^2$ = 0.798), which means a good predictive relevance. These values are higher than the typical thresholds for strong predictive capability in PLS-SEM (Kim et al., 2020). This was also validated using $Q^2$ values, calculated through blindfolding and they confirmed the model having an excellent level of predictive relevance.

**Table 3.** Structural Model Results

| Endogenous Construct | $R^2$ | Adjusted $R^2$ | Main Predictors | Path Coefficients (β) | Significance |
|---|---|---|---|---|---|
| LM | 0.619 | 0.604 | SU, CR | 0.349; 0.487 | $p < 0.05$ |
| PR | 0.798 | 0.786 | CR, LM | 0.470; 0.627 | $p < 0.05$ |

**Model Fit**

Information about the adequacy of the model can also be found in model fit indices. The Goodness of Fit (GoF) value obtained was 0.597 ( large effect size ), indicating that the model is not only robust but also significant in terms of explanatory power. An SRMR value of 0.086 suggested marginal fit and CFI at 0.827 was just under the recommended 0.90. According to covariance based metrics, the RMSEA value (0.117) was greater than conventional cut-off, which denotes a poor fit. For the same reason mentioned above, because PLS-SEM is exploratory, the model is still considered acceptable due to the large number of predictors chasing for the absolute fit indices (Chuah et al., 2024).

**Table 4.** Model Fit Indices

| Index | Value | Threshold | Interpretation |
|---|---|---|---|
| GoF | 0.597 | > 0.36 | Large effect |
| SRMR | 0.086 | ≤ 0.08 | Marginal fit |
| CFI | 0.827 | ≥ 0.90 | Marginal fit |
| RMSEA | 0.117 | ≤ 0.08 | Poor fit |

**Hypothesis Testing**

As shown in hypothesis testing summary, the majority of proposed relationships were supported. Also, LM significantly affected PR and LM also influenced PR thus confirming that LM acted as a mediator. CR overall had both a direct effect on PR and an indirect effect through LM, proposing that the latter is a key element in student readiness.

**Table 5.** Hypothesis Testing Results

| Hypothesis | Relationship | Path Coefficient | Result |
|---|---|---|---|
| H1 | SU → LM | 0.349 ($p < 0.05$) | Supported |
| H2 | SU → PR | (direct, weaker) | Partially |
| H3 | CR → LM | 0.487 ($p < 0.05$) | Supported |

| Hypothesis | Relationship | Path Coefficient | Result |
|---|---|---|---|
| H4 | CR → PR | 0.470 ($p < 0.05$) | Supported |
| H5 | LM → PR | 0.627 ($p < 0.05$) | Supported |
| H6 | SU → LM → PR | Significant | Supported |
| H7 | CR → LM → PR | Significant | Supported |

Collectively, the results show that curriculum relevance is the single largest predictor of both learning motivation and practical readiness, emphasizing the importance of connecting academic teaching to professional demands in forestry. At the same time, seedling understanding is the crux of motivation, and that leads to readiness. Motivation mediates between knowledge and practice, confirming theoretical statements that it is indeed the behavioral act of teaching students that psychological correlates are as important as the technical proficiency of the teacher who prepares students for situations outside of the classroom (Kim et al., 2020; Chuah et al., 2024). The strongest structural path was observed from learning motivation to practical readiness ($\beta = 0.627$), while seedling understanding showed a weaker direct effect on practical readiness.

**Discussion**

*Interpretation of Empirical Results*

Consistent with Self Determination Theory, this study confirms that technical knowledge alone is insufficient without motivational activation, extending previous findings in forestry education by empirically validating motivation as a mediating mechanism. The results showed a holistic view of the relationships of Seedling Understanding (SU), Curriculum Relevance (CR), and Learning Motivation (LM) that determine Practical Readiness (PR) among forestry students. Most of proposed hypotheses were statistically tested with strong evidence supporting the conceptual model using Partial Least Squares Structural Equation Modeling (PLS-SEM).

Hypotheses one to three assessed direct effects of SU and CR on LM. Statistical significance tests indicated that both relationships were significant (SU positively affected LM ($\beta = 0.349$, $p < 0.05$); CR had a larger and more positive effect on LM ($\beta = 0.487$, $p < 0.05$). These findings imply that the degree of technical knowledge students obtain about seedlings in itself would not belckkfvstve students without the relevant and meaningful perception of the curriculum they engage in. Hence H1 and H3 were supported.

As we shifted to direct impacts on PR, the evidence was mixed. CR had a strong effect on PR ($\beta = 0.470$, $p < 0.05$), suggesting that students who perceive the curriculum is aligned with professional and practical requirements would be more ready to practice. The effect of LM on PR was positive and strong ($\beta = 0.627$, $p < 0.05$) with the highest β coefficient confirming it as an essential contributor of readiness. Supporting evidence for H4 and H5 is provided by these findings. In practical terms, the direct pathway from SU to PR was weaker and less decisive than the indirect one, implying that seedlings knowledge itself does not indicate readiness, unless mediated by motivational pathways. Thus H2 was supported only in part.

Collectively, the model accounted for a significant portion of variance among the endogenous constructs, with an $R^2$ of 0.619 for LM and 0.798 for PR. These values imply a significant portion of variation is explained due to the predictors, confirming that the theoretical underpinning is robust. The evidence, therefore, substantiates the general theory that PR are encouraged by both SU and CR, with a significant part of this influence coming through LM.

*The Role of Learning Motivation as Mediator*

The results indicated strong support for the mediating role of LM—placing motivation as the (psychological) path that links knowledge and contextualisation design to field practice readiness. SU and CR provide the bones but LM is the phase is where action happens to the whole of those inputs.

Zou et al. Now, (2023) postulated that students who have a high intrinsic interest in a topic naturally employ newly gained knowledge into practice, and the results here confirm that. It seems that when students know how seedlings are grown and know that they understand it, they are more likely to want to test their skills in real life situations. In like manner, Huang and Yang (2021) prove that students who get related with learning material get a high level of motivation, and they become more prepared in practice workshops. Finally, the current research supports these findings showcasing that LM mediates the impact of SU and CR on PR.

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The relationship between CR and PR is also mediated by motivation. According to Huang and Zheng, (2022) appropriate alignment of curricula with professional development can stimulate motivation by associating abstract lessons to actual work activities. This study confirms that assertion: CR influences PR directly and CR also enhances the indirect effect on PR through LM. In this way, the LM acts as a double mediator, reinforcing knowledge-push and curriculum-push pathways to readiness.

The implications of these findings highlight that forestry education does not appear to simply concern the passing of knowledge or the design of curricula in isolation. But it also is about developing the intrinsic motivation that allows students to perceive relevance, invest in their learning, and use what they have learnt in the real world. Curricula must do more than merely offer the content needed to prepare a student for a desired adulthood (Hong et al., 2024). This view is still supported by recent evidence, highlighting that SU and CR without LM run the risk of failing to deliver on an authentic practice-ready student outcome.

*Linkages with Previous Studies in Forestry Education and Motivation Theory*

This study adds to an emerging literature seeking to draw on both the pedagogical and psychological features of forestry education. Traditional forestry training literature has often been biased towards the technical, that is, the silviculture, ecology, and management practices of forestry, with little emphasis on motivational or psychological aspects. The present study builds on that literature by providing empirical evidence showing how the enactment of LM mediates the influences of both knowledge and curriculum relevance on readiness.

Intrinsic motivation emerges in learners when they feel a sense of autonomy, competence and/or relatedness (McGraw Hills, N.D.) in a learning situation and this aligns with motivational theory a great deal, especially with Self-Determination Theory (SDT). With respect to SDT principles, therefore, SU supports competence, CR relates participants to their profession, and LM functions as the internalized motivation that brings SU and CR together into readiness to act. These ties support the theoretical claim that educational improvements are more powerful when all three of the cognitive, contextual, and motivational needs are satisfied by the same intervention.

Similar studies within forestry education have indicated that applied learning as well as internships and fieldwork are predictors of readiness (Duguid & Dey, 2014). This nuanced implication of students' motivation as a mediator in the relationship between students' past performance and academic interventions warrants further researchStudying the nature of motivation, the present study adds to this previous literature by demonstrating college students' motivation to engage in academic interventions helps to contextualize their efficacy (i.e., motivation mediatesthe effectiveness of such interventions). In short, you can have field-based training in a curriculum, but if LM isn't cultivated, the returns will be minimal. It emphasizes how course design and pedagogy need to incorporate strategies based on motivation.

*Practical Implications for Forestry Curriculum and Teaching*

These results provide a number of potential, actionable, implications for forestry educators and developers of forestry curricula. They first emphasize the importance of situating curriculum content in its real life context. Those students who see clear connections between what they are learning in the classroom and the work they will be doing in the field (and in life) are not only more willing to work hard but also much more prepared for practice. This requires a curriculum that merges theory with practice — with case studies, simulation exercises and experiential projects.

Second, the evidence indicates that motivational strategies should be a key component of instruction. In addition, utilizing pedagogical strategies like problem-based learning, working in groups on a field project, and reflective practice assignments can promote intrinsic motivation because they invite students to be active and take ownership of their learning. When developing the tasks which would be difficult and purpose in the same time, the educator can increase the competence and relevance of the students.

Lastly, institutions should implement wider programmatic interventions to ensure LM persists. This could be things like mentorship programs involving experts in forestry, channels for students to join conservation projects, or avenues for students to view the impacts of their work. Not only do these strategies cultivate motivation but they also provide avenues for envisioning students as professionals and helping to fortify readiness.

But the takeaway message is rather practical, we need to design our education in forestry to be informative but also inspirational. Knowledge and curriculum are fundamental, but good motivation makes it transformational. The

integration of motivational considerations into curriculum design and pedagogy within forestry programs will enable graduates to develop skills necessary to craft timely responses to important environmental issues e.g. deforestation, restoration and climate resilience. In tropical forestry contexts, where field adaptability and ecological complexity are high, motivation driven curricula become essential for developing practice-ready human resources.

*Limitations of the Study*

However, there are limitations to this study, which has strong findings. There are some limitations: the sample is relatively small, involving just 54 students being studied at a single forestry course. PLS-SEM is a robust method for small samples, but this also means that these results may not be able to generalize beyond the particular sample on which they were run. Studies incorporating larger, multi-institutional samples are needed to assess the generalizability of these findings.

Second, the study has been conducted in a particular local context namely students taking a certain level of class (Seedling Techniques). Other contextual factors, including institutional culture, teaching style, and curriculum design could be responsible for the results. This means that these findings should not be generalised without caution to any specific context of forestry education.

Third, cross-sectional design prevents making any causal claims or to catch the dynamic aspect of motivation and readiness for change. Motivation is not stable, it changes between years for students and when students are faced with a new challenge. These changes should be tracked with time using longitudinal research, as it is more better suited to track these types of changes over time.

Finally, the extensive use of self-reported measures may be subject to biases like social desirability bias or overestimation of readiness. Future studies might include performance-based assessment or triangulate survey data with observation or qualitative data to get a fuller picture.

*Recommendations for Future Research*

Guided by these limitations, we propose several avenues for future research.

1. There is first a need for comparative studies across countries or regions. Contextualisation of forestry education is, however, highly variable and is influenced by ecological, cultural and professional differences. Conducting such a cross-country comparison would enable researchers to explore the extent to which the mediating role of LM is invariant across context or moderated by certain cultural or institutional characteristics.
2. Third, longitudinal investigations are suggested to follow the interplay of SU, CR, LM, and PR over time. This research could help uncover whether or not the impacts seen here carry over, intensify or decay over students' educational and career trajectories. Students may also engage in such work in longitudinal designs, such as through being exposed to internships and other fieldwork or early career experience, that would reflect changes in motivation.
3. Third, mixed-methods approaches could enhance understanding through the addition of qualitative insights. Conducting interviews or focus groups with students could uncover how curriculum relevance and motivation manifest in their readiness. Similarly, case studies on forestry programs that effectively integrate motivational strategies can provide practical models of replicable approaches.
4. Lastly, moderating variables, for example, gender or previous experience with forestry or cultural inclination to environmental stewardship should be part of future research. These factors may shape student perceptions of curriculum relevance, or motivation may not transfer into readiness. Analyzing this kind of variables allows researchers to test specific hypotheses, improving theoretical models and offering more tailored implications for educational practice.

The emergent themes in the discussion of findings reveal a driving message: readiness for practice cannot be reduced to content knowledge or curriculum design, but rather is a reflection of the motivational forces that link the two. Competence is built by SU and Context and Relevance is given by CR but LM is the mediating catalyst that takes SU and CR to true Readiness.

The significance of this study lies both in its empirical and theoretical contributions, as it illustrates the importance of the role of LM as a mediator, applies motivational theory to forestry education, and provides suggestions for curriculum design and pedagogy. While recognising its own limitations, it also emphasises the need for further, more nuanced and robust research to corroborate and expand on its findings.

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Overall, the findings present a challenge to forestry educators (and others) to go beyond the conventional notion of the theory-practice split, to a more holistic conception of learning, which include cognitive, contextual and motivational aspects of education experiences. This would enable forestry education to enhance students' both technical skills associated with becoming effective professionals as well as the motivation and willingness to deploy these skills in addressing urgent sustainability problems, including climate change.

## CONCLUSION

This study demonstrates that learning motivation is the strongest predictor of practical readiness ($\beta = 0.627$), mediating the effects of seedling understanding and curriculum relevance. While curriculum relevance also exerts a direct effect on readiness, seedling understanding primarily influences readiness through motivation. These findings suggest that forestry curricula should integrate technical training with motivationally rich, practice-oriented learning. Such integration is critical for strengthening human resource capacity in tropical forestry management

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