CHAPTER – V

Major Findings, Conclusions and Recommendations:

5.1 Major Findings

- A majority (87 %) of pupil-teachers have heard about Atal Tinkering Labs, indicating broad conceptual recognition. However, only 32 % know the specific eligibility criteria for schools to establish an ATL, and 38 % are aware of the financial support mechanisms highlighting that depth of practical knowledge remains limited despite high nominal awareness.
- While 62 % of pupil-teachers have visited an ATL-equipped school, fewer than one-third (29 %) have personally participated in ATL activities during their own schooling. Moreover, only 24 % have received any formal training in ATL technologies, and 41 % are familiar with basic coding languages used in ATLs (e.g., Scratch, Python). This gap suggests that firsthand, hands-on experience and structured training among pupil-teachers remain inadequate.
- A strong majority (84 %) understand the "Do-It-Yourself" ethos of ATLs, and 77 % correctly identify that ATLs primarily focus on the science domain. Additionally, 72 % acknowledge that ATL activities are integrated into the regular school curriculum, and 58 % know about ATLs' emphasis on design thinking. 48% are aware about provisions for college students under AIM whereas 52% are not aware about the opportunity which require more awareness programs.
- Large majorities of respondents agree that ATLs foster 21st-century skills (85 %), promote hands-on, experiential learning (82 %), enhance STEM education (81 %), and support innovation and creativity (82 %). Similarly, 85 % feel ATL should be part of teacher-education curricula, and 86 % assert that teachers need regular ATL training to remain effective demonstrating overwhelmingly positive attitudes toward ATL's potential.
- Each perception item includes a substantial "Can't say" percentage ranging from 12 % to 25 % which signals that many pupil-teachers remain unsure about ATL's feasibility (e.g., introducing ATLs in all schools: 20 % undecided) and long-term impact (e.g., influence on employability: 25 % undecided).

- Descriptive statistics show that mean awareness scores across courses range from 7.25 (B.A. B.Ed.) to 9.35 (BSc. B.Ed.), but the one-way ANOVA yields $F = 1.13$, $p = 0.345$, indicating no statistically significant difference in awareness levels by teacher-education program.
- Mean perception scores rise from 9.75 (B.A. B.Ed.) to 13.74 (Int. B.Ed.–M.Ed.), and the one-way ANOVA yields $F = 3.465$, $p = 0.0109$, demonstrating a significant effect of course type on ATL perception.
- Pairwise t-tests revealed that the Int. B.Ed.–M.Ed. cohort's perception is significantly higher than both the B.A. B.Ed. and ITEP cohorts ($p = 0.0018$ and $p = 0.0258$, respectively), while all other program comparisons were non-significant.

5.2 Discussion and Conclusions:

- This study investigated awareness and perceptions of Atal Tinkering Labs (ATLs) among 100 pupil-teachers enrolled in various teacher-education programs at RIE Bhopal. Using a descriptive survey design, data were collected via a structured questionnaire, generating both dichotomous "Yes/No" items on awareness and three-point (Agree/Disagree/Can't say) Likert-type items on perceptions. Percentages described overall awareness and perception patterns, while one-way ANOVA tested for differences across the five course categories: B.A. B.Ed., B.Ed., BSc. B.Ed., ITEP, and Int. B.Ed.–M.Ed.
- Key results reveal that although almost nine in ten pupil-teachers have heard of ATLs, only a minority know the eligibility criteria or have received formal training. Hands-on experience (e.g., visiting ATL-equipped schools) is moderate (62 %), but actual participation or pedagogical confidence remains low. Perception data show extremely positive attitudes toward ATL's role in developing 21st-century skills, supporting STEM education, and promoting innovation; nonetheless, 12 %–25 % of respondents remain undecided on each perception statement. While awareness does not significantly vary by course, perception does: the Integrated B.Ed.–M.Ed. cohort exhibits significantly higher, more consistent positive views compared to other groups.
- The study concludes that, despite widespread conceptual recognition, many pupil-teachers lack the practical knowledge, training, and confidence to act as effective ATL facilitators. Furthermore, the variation in perceptions by program suggests that

integrated or advanced teacher-education curricula (e.g., Int. B.Ed.–M.Ed.) more thoroughly institutionalize ATL concepts than other courses.

- Although ATLs are widely known among pupil-teachers, detailed knowledge such as setting up an ATL, securing funding, or using specialized tools (e.g., 3D printers, coding platforms) is confined to fewer than half of respondents.
- Pupil-teachers agree that ATLs are valuable for fostering 21st-century competencies, hands-on learning, and STEM enhancement; however, a nontrivial "Can't say" segment on each item underscores that direct experience and informed conviction are still lacking.
- Less than one quarter of respondents have undergone formal ATL training, and only about 48% are aware about provisions for college students under AIM whereas 52% are not aware about the opportunity. Almost 88 % express willingness to receive formal training, confirming a clear demand for structured professional-development modules.
- While general awareness does not differ significantly across teacher-education programs, perceptions do. The Int. B.Ed.–M.Ed. cohort manifests the strongest, most uniform positive views, implying that its curriculum likely integrates ATL concepts more deeply. Other courses (especially B.A. B.Ed. and ITEP) display greater variability and lower mean perceptions, suggesting uneven exposure to ATL principles.
- To realize AIM's goal of "Tinkering in Schools," teacher-education curricula must embed ATL content both theoretical and practical so that all future teachers, regardless of program, graduate ready to facilitate ATL activities effectively. Without such integration, ATL adoption may remain superficial in many contexts.

5.3 Recommendations:

- Regulatory bodies (e.g., NCTE, UGC) and teacher-education institutions should mandate dedicated ATL-oriented modules in all B.Ed. and integrated programs. This could include practicum hours spent in active ATL settings, hands-on workshops for coding/3D printing, and coursework on design thinking.
- Given that 78 % of respondents believe infrastructure is a precondition for meaningful ATL participation, state and central education departments should allocate targeted grants to teacher-education colleges for establishing demonstration ATL units allowing pupil-teachers to gain firsthand experience.

- Develop a cascading training model where master trainers (e.g., at RIEs and DIETs) receive comprehensive ATL certification, then conduct district-level workshops for in-service teachers and pre-service cohorts. This tiered approach addresses the gap only 24 % have been trained by ensuring ongoing upskilling.
- As 20 % of respondents are unsure about extending ATLs to all schools, policymakers must provide additional support (e.g., funding, mobile ATL units, industry partnerships) to ensure rural and resource-constrained institutions can feasibly implement ATLs.
- Since a substantial "Can't say" cohort remains uncertain about ATL's long-term impact, robust M&E frameworks should track ATL outcomes (e.g., student innovation projects, skill acquisition) and disseminate success stories at regional conferences, creating evidence-based advocacy.
- Encourage stronger partnerships between teacher-education institutions and local industries or MoC mentors. Embedding industry mentors in pre-service practicum experiences can reinforce the real-world relevance of ATL tools/techniques.