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CHAPTER VI
SUMMARY AND CONCLUSIONS

6.0 Introduction

"Every teacher and educationist of experience knows that even the best curriculum and the most perfect syllabus remain dead, unless quickened into life by the right method of teaching and right kind of teacher". (Secondary Education Commission, 1952-53).

National Policy on Education (NPE, 1986) states, "the status of the teacher reflects the socio cultural ethos of a society. No people can rise above the level of its teachers." A teacher’s role is central, vital and pivotal in shaping knowledge and personality of children. The best approach towards achieving excellence in higher education is to impart necessary skills and an indepth knowledge of subject matter in the teachers. Therefore developing excellence among teachers is very vital in improving the quality of education. The quality, commitment, concern, devotion and competence of a teacher depends upon the teacher training which they receive during the preservice teacher education course. And hence teacher education programmes must make all the efforts to nurture excellence among future teachers.

National Curriculum Framework for School Education (NCERT, 2000) insists on the development of understanding science through thinking and problem solving. Hence prospective teachers of science should be engaged actively in the processes that would help them to acquire scientific habit of mind.
This scientific habit of mind inculcated among the teacher trainees during teacher practice would help them to teach their students in scientific inquiry and help them to deal sensibly with problems of life. Only competent teachers can engage their students in activities that will lead to thinking and problem solving. This quest for better competent teachers has led the investigator to search for quality teacher education.

Grossman (1991) contends that if teachers are to guide students in their journey into unfamiliar territories they need to know their domain well. Both the knowledge of content and the knowledge of the best way to teach the content to students help teachers construct meaningful representations. Since content knowledge permeates every area of teaching, it is important to enrich content knowledge of teachers for effective instruction. Empirical evidences show that subject matter knowledge has greater impact on teacher’s instructional practices. (Smith and Neale, 1989; Carlson, 1991 and Shulman, 1996). However, review of related literature reveals that very little research is being done in India to assess the relationship of subject matter knowledge to teaching competency. The present study would explore the relative importance of content knowledge in enhancing the teaching competency of the teacher trainees.

The Programme Of Action of National Policy on Education (NPE, 1986) has pointed out that while selecting teachers, persons who are given evidence of interest in teaching, love for children, spirit of adventure, creativity and commitment for social upliftment will be preferred. To enhance the quality of
education, it is imperative to select proper persons for the teaching profession. Before admitting the student teachers to teacher education programmes, there should be a provision to assess the basic skills, traits and abilities as well as aptitude for teaching which are the pre-requisites for successful teaching. The quality, commitment and competence of the teacher trainees should be assured. And hence the selection of the teacher trainees should be regulated through aptitude test and content test and not entirely based on university grade or marks.

Teacher education programmes should be planned in a manner that it should provide sufficient scope for maximum utilization of originality, spontaneity and creative potential of student teachers. The teacher’s capacities and abilities have to be developed to the level of excellence. Science teacher has to be an expert communicator. Valicha (1993) gave stress on training in the use of gestures, voice, dialogue and humour. Therefore, adequate time should be provided for development of communication skills and teaching skills. Thus teacher education programmes may lead to guided practice in sharpening skills which would enhance their teaching competency. Therefore it was thought necessary and appropriate to investigate the effect of subject matter knowledge, problem solving ability and teaching aptitude of the teacher trainees on their teaching competency. Hence this study “Problem Solving Ability, Aptitude and Competency in Teaching Science of Trainees in Colleges of Education in Kerala.”
6.1 Research Design and Method

6.1.1 Main Objectives of the Study

The following are the main objectives of the study.

i) To explore whether teacher trainees in the colleges of education differ in i) mastery in subject content of high school Biology ii) problem solving ability iii) teaching aptitude iv) performance in science at degree level and v) teaching competency owing to variations in the personal variables, namely gender, region, qualification of the teacher trainees, college management type, education of father, education of mother, occupation of father, occupation of mother and parental income.

ii) To investigate the relationship between the variables, namely, a) mastery in subject content of high school Biology, b) problem solving ability, c) teaching aptitude, d) performance in science at degree level e) teaching competency.

iii) To examine the relationship between components of teaching competency, and a) mastery in subject content of high school Biology, b) problem solving ability, c) teaching aptitude, d) performance in science at degree level.

iv) To find the relationship between components of teaching aptitude and a) mastery in subject content of high school Biology, b) problem solving ability, c) performance in science at degree level, d) teaching competency.

v) To predict teaching competency of the teacher trainees in terms of a linear combination of a) mastery in subject content of high school Biology, b) problem solving ability, c) teaching aptitude and d) performance in science at degree level.
vi) To predict teaching competency of the teacher trainees in terms of a linear combination of components of teaching aptitude.

vii) To predict the teaching competency of the teacher trainees in terms of a linear combination of selected personal variables and a) mastery in subject content of high school Biology, b) problem solving ability, c) teaching aptitude d) performance in science at degree level.

viii) To explore which of the selected variables effectively discriminate between high competent and low competent teacher trainees.

ix) To construct and validate a model of causal relationship among the selected personal variables, mastery in subject content of high school Biology, performance in science at degree level, teaching aptitude, problem solving ability and teaching competency of the teacher trainees.

6.1.2 Hypotheses

Keeping the above objectives in view, the following hypotheses were formulated.

H₁ Teacher trainees in the colleges of education differ in i) mastery in subject content of high school Biology, ii) problem solving ability, iii) teaching aptitude, iv) performance in science at degree level and v) teaching competency owing to variations in a) gender b) region, c) qualification of the teacher trainees, d) college management type e) education of father, f) education of mother, g) occupation of father h) occupation of mother and i) parental income

H₂₁ There is significant relationship between i) mastery in subject content of high school Biology and

a) problem solving ability c) performance in science at degree level

b) teaching aptitude d) teaching competency
ii) problem solving ability and
   a) mastery in subject content   c) performance in science
      of high school Biology       at degree level
   b) teaching aptitude           d) teaching competency

iii) teaching aptitude and
   c) mastery in subject content   c) performance in science
      of high school Biology       at degree level
   a) problem solving ability      d) teaching competency

iv) performance in science at degree level and
   a) mastery in subject content   c) teaching aptitude
      of high school Biology
   b) problem solving ability      d) teaching competency

v) teaching competency and
   a) mastery in subject content   c) performance in science
      of high school Biology       at degree level
   b) problem solving ability      d) teaching aptitude

$H_{2.2}$ There is significant relationship between components of teaching competency and
   a) mastery in subject content   c) performance in science
      of high school Biology       at degree level
   b) problem solving ability      d) teaching aptitude

$H_{2.3}$ There is significant relationship between components of teaching aptitude and
   a) mastery in subject content   c) performance in science
      of high school Biology       at degree level
   b) problem solving ability      d) teaching competency
H₃.1 A linear combination of the variables namely mastery in subject content of high school Biology, problem solving ability, teaching aptitude and performance in science at degree level significantly predicts teaching competency.

H₃.2 A linear combination of components of teaching aptitude significantly predicts teaching competency.

H₃.3 A linear combination of all the selected personal variables in the study and the variables namely mastery in subject content of high school Biology, problem solving ability, teaching aptitude and performance in science at degree level significantly predicts teaching competency.

H₄ All the selected personal variables and the variables namely the mastery in subject content of high school Biology, problem solving ability, teaching aptitude and performance in science at degree level together discriminate the high competent and low competent teacher trainees.

6.1.3 Tools used for the Study

The following tools were used for the present investigation.

i) A test on Mastery in Subject Content of High School Biology developed by the investigator.

ii) Problem Solving Ability Test devised by the investigator.

iii) An adapted version of standardized General Teaching Competency Scale (GTCS) prepared by Passi and Lalitha (1979).

iv) Teaching Aptitude Test Battery (TATB) prepared and standardized by Karim and Dexit (1986).
v) The marks secured by the teacher trainees in science in their B.Sc Degree Examination conducted by the University as recorded in the college register.

vi) Personal Data Sheet to collect the data on selected personal variables.

6.1.4 Sample for the Main Study

An optimum sample fulfils the requirements of the representation. "The larger the number, the larger the S.D. of the sample and more inclusive (presumably representative), our sample becomes of the general population". (Garret, 1969, p.208). Cluster sampling technique was used for selecting the sample from the randomly selected 34 colleges of Education ie. the data was collected from all the teacher trainees of the Natural science optional (complete count of all the items). Thus 756 teacher trainees of regular B.Ed. course (Natural Science Optional) admitted to 34 colleges of education for the academic year 2003-2004 constituted the sample for the present study. Since the sample comprised teacher trainees of Natural Science Optional, the researcher had to cover nine districts of Kerala to collect an optimum sample for the study.

6.1.5 Collection of the Data

The collection of the data was done in two stages. During the first stage, the investigator selected 36 colleges of education in Kerala by random sampling. Permission was sought from the concerned principals of the colleges to collect the data from teacher trainees who had opted for Natural Science. The investigator visited the colleges in person in the month of October/November 2003 to collect the data.
The Test on Mastery in Subject Content of high school Biology, Problem Solving Ability and Teaching Aptitude were administered to the B.Ed. trainees. (Natural Science Optional). Personal data sheet was used to collect information on personal variables. The marks obtained by the teacher trainees in science in their B.Sc. Degree Examination, were collected from the college registers as scores for the teacher trainees' performance in science at degree level.

In order to assess the teaching competency of the teacher trainees, the investigator met the Biology teacher educators in selected colleges and their help was sought to assess the teaching competency of the teacher trainees. The teacher educators were given instructions and guidelines as to the effective use of General Teaching Competency Scale. The teacher educators were asked to assess the teaching competency of the teacher trainees twice during the internship, one at the beginning of the teaching practice and again towards the end of the teaching practice. The average of the ratings was taken as the score for teaching competency. Second phase of the data collection was done, in the month of January, 2004. The researcher met all the optional teachers of the concerned institutions and collected back the rated teaching competency tools.

6.1.6 Design for the Analysis of Data

After processing the data, it was classified into various groups and subgroups based on the selected personal variables and their categories and were treated for statistical tests of significance to test the hypotheses using SPSS package. The following statistical analyses were used.
i) Descriptive Analysis using Mean and Standard Deviation.

ii) Differential Analysis using Analysis of Variance and ‘t’ tests.

iii) Correlational Analysis using Pearson’s Product Moment Method.

iv) Multivariate Analysis using Multiple Regression Analysis, Discriminant Analysis and Path Analysis.

6.2 Major Findings of the Study

i) Male teacher trainees are at a higher level in their problem solving ability in science than female teacher trainees. Female teacher trainees are significantly higher in their performance in science at degree level than male teacher trainees. However male teacher trainees are found to be on par with female teacher trainees in their a) mastery in subject content of high school Biology b) teaching aptitude and c) teaching competency.

ii) Teacher trainees from urban areas are found to have a better aptitude for teaching, higher level of performance in science at degree level and better teaching competency than their counter-parts from rural areas. However teacher trainees from rural and urban areas are on par with each other in their mastery in subject content of high school Biology and problem solving ability.

iii) Post graduate teacher trainees are found significantly higher in their performance in all the selected variables in the study than graduate teacher trainees
iv) Teacher trainees from government colleges/university centres and aided colleges are at a higher level in their mastery in subject content of high school Biology, problem solving ability and performance in science at degree level than those who got trained at unaided colleges. Teacher trainees from aided colleges are found to be more competent in teaching than those from government colleges/university centres and unaided colleges. Variation in college management type does not produce significant differences in teaching aptitude.

v) There is a significant increase in the teacher trainees' performance in science at degree level and teaching competency as the parental education levels and parental income increase. Teacher trainees whose mothers have higher educational qualification have a better level of performance in their mastery in subject content of high school Biology. However, teacher trainee's problem solving ability and teaching aptitude are not found to be influenced by the SES of their parents.

vi) Significant and positive relationship is found between all the selected variables in the study namely, a) mastery in subject content of high school Biology b) problem solving ability c) teaching aptitude d) performance in science at degree level and e) teaching competency. Teacher trainees with high teaching aptitude and problem solving ability together with high level of
performance in science at degree level and mastery in subject content of high school Biology are found to be competent in their teaching than others.

vii) All the components of teaching competency are significantly related to mastery in subject content of high school Biology, problem solving ability and performance in science at degree level. However, only two components of teaching competency namely planning skills and closing skills are significantly related to teaching aptitude.

viii) All the components of teaching aptitude except optimistic attitude and dynamic personality are significantly related to a) mastery in subject content of high school Biology b) problem solving ability c) performance in science at degree level and d) teaching competency.

ix) The most important predictor of teaching competency is the qualification of the teacher trainees followed by performance in science at degree level, mastery in subject content of high school Biology and SES in that order. All the selected variables in the study are collectively well associated with teaching competency of the teacher trainees. 16.1 per cent of variance in teaching competency is explained by a linear combination of all the selected variables and personal variables in the study.
x) Among all the components of teaching aptitude, optimistic attitude and wide interest and scholarly taste significantly predict teaching competency. All the components of teaching aptitude are found collectively well associated with teaching competency. 3.9 per cent of variance in teaching competency is explained by a linear combination of all the components of teaching aptitude.

xi) The qualification of the teacher trainees, performance in science at degree level, mastery in subject content of high school Biology, problem solving ability, college management type, socio economic status and region are the significant predictor variables for group identification of high competent and low competent teacher trainees.

xii) Path analysis revealed that qualification of the teacher trainees, performance in science at degree level, mastery in subject of high school Biology, and SES have stronger direct effects on teaching competency. Qualification of the teacher trainees is found to have the strongest direct and total effects on teaching competency compared to other variables in the study. Region and problem solving do not show direct effects on teaching competency. However these two variables have high indirect effects on teaching competency.
6.3 Educational Implications of the Findings of the Present Study

The findings of the present study have many implications in the teacher education programmes where competent and dedicated teachers are being moulded. These findings throw light on achieving excellence in teaching profession as well as evolving new criteria for admission to teacher education programmes.

6.3.1 Integration of Content and Pedagogy in Teacher Training Programmes

The present investigation highlights significant relationship between mastery in subject content of high school Biology and teaching competency of the teacher trainees. Mastery in subject content of high school Biology is found to be the significant predictor of teaching competency. If teachers are to guide their students, they need to know their domain well. Both the knowledge of the content and knowledge of the way to teach that content to students help the teachers to integrate the content and pedagogy in teaching. Since limited subject mastery severely affects performance of teachers, especially in view of explosion of knowledge, teacher training programmes should include discussions, debates, seminars and workshops which will be helpful to update and upgrade their stock of content knowledge at regular intervals. Content enrichment programmes should be arranged to bridge the gaps in their knowledge domains and help teacher trainees to achieve academic excellence.

6.3.2 Changing Instructional Strategies in Teacher Education

The present study revealed that teacher trainees from government and aided colleges who were found similar in their performance in science at degree
level and mastery in subject content of high school Biology, differed significantly in their teaching competency favouring those trainees from aided colleges. This finding highlights the positive influence of instructional strategies that could be given in teacher training colleges towards sharpening the teaching skills. The instructional strategies may include workshops on microteaching, simulation and demonstration of model lessons using a variety of techniques.

The science teacher training programmes should include the well defined set of indicators as competencies for effective teaching and provide students with multiple ways to display science teaching competencies in the classroom settings. These indicators of effective teaching have to be consistent with best practice as defined earlier. And these practices may be based on a solid, well-articulated rational programme with sufficient time. Arrangement of experiences must be to ensure that the candidates acquire the desired competencies. The teacher training programmes should include a variety of contemporary assessment practices to measure performance in the most authentic and diverse settings available.

6.3.3 Science Classrooms for Thinking and Problem Solving

The present study revealed that problem solving ability of the teacher trainees is significantly related to their teaching competency. Any training which is not in line with the updated information, which is not promoting reflective thinking and problem solving, will not remain feasible for the practical conditions. The methods taught two or three years back, will become outdated
and will not be useful for the applicability to real life situation. Tomorrow’s illiterate will not be the man who cannot read, he will be the man who has not learnt how to learn.

The teacher educator skillfully should facilitate class room discourse through questioning, reflecting on and critically analysing ideas leading teacher trainees towards a deeper understanding of inquiry process itself. A significant factor in a teacher educator’s role is to help teacher trainees accept the challenge to build a classroom where they want to solve the problems. Life skills, linkage of knowledge, logical approach, experimentation, abstraction and collaboration will be getting importance in the future teachers’ training than subject knowledge and educational theories. A thinking classroom can be established by:

- Nourishing thinking of teacher trainees providing encouragement, support and motivations for them.
- Providing thinking opportunities by framing learning assignments around thoughtful questions, provoking puzzlement, and engaging the teacher trainees in knowledge-providing activities.
- Supporting and guiding student teacher thinking.
- Making visible and explicit thinking of teacher trainees (face to face communication, argument and debate which motivate thinking abilities).
- Active intellectual engagement like asking each student teacher to think aloud, to know the way of thinking or ask students to share
their conceptual and procedural knowledge and solve the problem together.

- Opportunities for inquiry which regularly require critical thinking and identification of the researchable questions at an appropriate level.

- Asking the right questions exploring the art of provoking student teachers to apply their knowledge to solve problems.

6.3.4 Evolving New Criteria for Admission to B.Ed. Courses

Among all the variables selected for the present study, qualification of the teacher trainees is found to be best significant predictor for teaching competency. A comparison of graduate and post graduate teacher trainees revealed that teacher trainees differed significantly in all the selected variables such as mastery in subject content of high school Biology, problem solving ability, teaching aptitude, performance in science at degree level and teaching competency favouring post graduate teacher trainees. The results of regression analysis, discriminant analysis and path analysis also supported this finding. Since postgraduate teacher trainees excelled over their counterparts in their teaching competency, it would be appealing to raise the qualification for B.Ed. admission from that of Bachelor’s degree to Master’s degree. Further, the present study revealed that performance in science at degree level and mastery in subject content of high school Biology significantly predict teaching competency of the teacher trainees. Therefore it may be inferred that teacher trainees who have performed well at degree level and having a strong content base of high school Biology can be successful in their classroom teaching. Therefore it would
be imperative to select teacher trainees for B.Ed. course on the basis of these two factors. A Common Entrance Test to assess the candidate’s content knowledge of high school Biology as well as their performance in science at degree level may be considered as an admission criteria to B.Ed. course. 50 per cent weightage may be given to entrance examination marks and 50 per cent weightage may be given to their performance in science at degree level for the B.Ed. admission.

5.3.5 Faculty Improvement Programmes for Teacher Educators

Quality, commitment, competence and character of teachers are the most significant factors to qualify a teacher educator to be effective in his/her profession. Successive commissions, committees and other learned bodies on education have highlighted the establishment of a system of incessant in-service training of teacher to build up their indepth knowledge of content and teaching potential. The Malhotra Committee Report of UGC (1986) recommended an inbuilt structure of faculty development programmes which has been implemented in all Indian Universities. The report recommends making provisions for college and university teachers to acquire higher degree of M.Phil and Ph.D. and also creating facilities for orientation and refresher courses for teacher educators. Quality in teacher education is a positive and dynamic idea to be achieved by meaningful investment. (Stallis, 1996; Navaratnam, 997). Shejwalkar (1999) states, “afterall quality is essentially a product of ntensive investment of capital – talent and hard work. Quality is not a chance, but a choice. Quality is not a destination, but a continuous journey” (p.15).
And hence teacher educators should be encouraged to undertake doctoral and post doctoral research to provide direct inputs for the improvement of teacher development programmes. For this purpose, fellowships at senior levels should be instituted and provision should be made for sabbatical leave.

Teacher educators should be strengthened with a continuous supply of relevant learning materials including journals. Provision should be made for every teacher educator to attend inservice programmes according to their specific needs and requirements. Teachers should have freedom to innovate, to devise appropriate methods of communication and activities relevant to the needs and concerns of the community.

6.3.6 Male Touch in Teaching Profession

The present study reveals that recently the number of male teacher trainees getting enrolled in the colleges of education are generally declining in Kerala as compared to female teacher trainees. Out of 34 colleges from where the sample was collected, 27 colleges have co-educational facilities. The sample comprised of only 78 male teacher trainees out of 756. From this, it may be inferred that in the near future in Kerala, teaching profession in Biological science will become a female domain.

It is always healthy to have both male and female teachers for science teaching. The present study revealed that there existed significant gender difference in problem solving ability favouring male teacher trainees. Though female teacher trainees were better in their university total marks, they couldn't
perform well in Problem Solving Ability Test. This shows that male teachers can contribute more towards thinking and problem solving. Hence it would be ideal if we avail the services of male teachers in science class rooms. For this, teaching should be regarded as one of the noblest professions. Many of the abler graduates coming out of universities are lured away from teaching profession by more attractive salaries offered by the corporate houses and also by relatively better salaries and opportunities in the superior services of the Government. And hence the Government and the community should endeavour to create conditions which will motivate and inspire male graduates towards teaching profession.

6.6.4 Suggestions for Further Research

i) This study is confined to the teacher trainees in the colleges of education in Kerala. The same study may be carried out in other states to explore how far mastery in subject content of high school Biology, problem solving ability performance in science at degree level and teaching aptitude of the teacher trainees contribute towards class room performance of the teacher trainees.

ii) Thinking and problem solving approach in science classrooms is an accepted area in science education. Probably very little attention is paid to execute it. Hence more investigation is to be done in this area.

iii) Research studies can be carried out to explore how far the problem solving skills developed in science classrooms are helpful to solve life problems.
iv) More investigations may be carried out to explore the modern competencies to be equipped with the science teachers to work efficiently to cater to the needs of the information society.

6.5 Conclusion

It can be concluded that mastery in subject content of high school Biology, problem solving ability, performance in science at degree level, and teaching aptitude are the determinants of teaching competency. Factors like qualification of the teacher trainees, parent's education, parent's income and socio economic status of the parents greatly influence the teaching competency of teacher trainees.

The teachers are the architects who shape the destiny of nation, custodian of culture and torchbearer of humanity. Competent teachers, a scarce and valuable resource, should be treated as a national asset and hence all efforts should be taken in teacher education programmes to train and produce resourceful and competent future teachers.