

Supplementary Volume No. IV-B

**Evidence led before the
EDUCATION COMMISSION**

*Professional,
Vocational & Technical Education*



**EDUCATION COMMISSION
University Grants Commission Building
Bahadur Shah Zafar Marg
New Delhi
1966**

SUPPLEMENTARY VOLUME NO. IV-B

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EDUCATION COMMISSION
GOVERNMENT OF INDIA

Technical Education: Analysis of Evidence

Introduction:

In addition to the general questionnaire issued by the Education Commission covering all aspects of Education, a separate questionnaire raising specific issues of Technical Education was issued by the concerned Task Force. Wide publicity was given to these questionnaires. The Principals of all Engineering Colleges, Polytechnics, I. T. Is., representatives of industry, State Directors of Technical Education and other individuals interested in Technical Education were contacted. The response has been very encouraging. A large number of replies have been received.

Further, the Education Commission has also received a very large number of memoranda from the public, containing many valuable suggestions for the improvement of Technical Education. All the important views are called and presented in the succeeding paragraphs. While ensuring, to the extent possible, that repetitions of the same suggestions are avoided, all shades of opinion expressed are reproduced.

For convenience of reference, these suggestions have been grouped under the following heads:

- (i) Philosophy and objectives of Technical Education
- (ii) Pattern of Technical and Vocational Education
- (iii) Introduction of crafts and technical skills at primary stage
- (iv) Junior Technical Schools and Multipurpose Schools.
- (v) I. T. Is./App. Training
- (vi) Polytechnics
- (vii) First Degree colleges
- (viii) Post-graduate studies and Research
- (ix) Reforms in Examination System.
- (x) Wastage.
- (xi) Equipment.
- (xii) Medium of Instruction
- (xiii) Part-time/Correspondence Course
- (xiv) Cooperation with Industry
- (xv) Teachers
- (xvi) Administration
- (xvii) Suggestions for improvement of Technical Education in general.

I. Philosophy & Objectives of Technical/Vocational Education

1. Mere skill or competence for an individual to be economically adjusted in the Society is not enough. As American educationists feel "The goal of vocational education is to produce a competent worker and a citizen who is economically, socially, emotionally and physically adjusted.... Emphasis is not to be placed solely on the development of skills and good habits of work. The whole educative process of the individual is of prime consideration".
2. The honour and dignity of manual labour has not always been fully recognised in India. To fight the "white-collar" frame of mind, technical training should be inseparably linked with work experience and some form of Apprenticeship Curricula should be adapted to technological changes and progress. Close liaison with industry is therefore necessary.
3. At every stage of education, the aim should be to promote agriculture, knowledge and skill, intellectual development along with practical ability and training for some vocation i.e. socially useful and personally rewarding since moral and spiritual qualities form the foundation of national strength and social and individual welfare. Efforts should be made to bring the students into close and stimulating contacts with the inspiring cultural and spiritual ideas and traditional values of India.
4. The curricula should be attuned to the growing complexity of Indian life and the needs of broadly based democracy putting new stress on practical training in the field of Agriculture, Science, Technology, Social Sciences and Literature. But emphasis in this direction should not lead to robbing higher education of Unity and Direction, thus maintaining a sound set of values for equipmen of an enriching and matured inner life along with practical abilities.
5. In short, the sheet anchor of Educational Policy should be to make Education serve the pressing demand of daily living, and accordingly, there should be provision for a wide variety of elective courses so that students can combine specialised skills with general knowledge and education. Equal emphasis should be given to general education and to special training in a chosen field of skill or ability.

6. Emphasis should be on "education for productivity". To achieve this, large scale vocationalisation at different stages and in a variety of ways is necessary.
7. The inadequacy of vocational training is a crying and growing problem of our country. Concentration on full vocational and craft training at the secondary level would be unwise. The training in formal schools is very expensive, competent teachers are not available and the needs of specific crafts are difficult to forecast. It should be remembered that this training is nearly 5 times costlier than general education at comparable level. This public and private employing establishments are able to give such training better and at less cost. Formal schools should be for general education only; and only when absolutely necessary, they should undertake vocational and craft training also. This training will be more productive if the trainees have had an adequate secondary education which includes some science and mathematics as well as technically oriented subjects and shopwork.
8. Languages, social studies, general science and mathematics as well as co-curricular activities should be included in secondary schools intended to give the students a practical bias. In all such institutions, the theoretical aspect should get a secondary place. This practical training should be in vocations useful in life. Candidates attending these schools should not be debarred from higher education altogether. Opportunities for higher studies in their lines of specialisation should be provided.
9. According to some, however, these schools instead of giving just a practical bias should be complete by themselves, with scope for higher qualifications.
10. Technical education should be taken to mean general education of technical subjects i.e. basic scientific knowledge of technical gadgets, etc. Vocational education should mean education and training that will enable a person to pursue a particular vocation and should involve imparting of skill and related technical knowledge. Professional education should stand for fairly wide knowledge of the profession formed by grouping together of different trade skills.

II. Pattern of Technical/Vocation Education

II.a) Diversification:-

1. Divergent views are expressed about the appropriate stage for diversification. These are almost equally divided ^{h/5th standard} between age 13/14 plus (10th/11th standard i.e. after Matriculation). Stray suggestions to the effect that this diversification should be at 4th/5th standard are also received.
2. Many feel that vocational training to school leavers, (irrespective of the stage of drop out) should be in institutions entirely separate from schools. Contents and courses of these institutions should be closely linked with industrial practices.
3. Admission should be by a competitive examination, including aptitude rating. There will be no dearth of applicants if doors of higher general/professional education are kept open to them.
4. Many others, however, believe that if vocationalisation is to succeed, all education between the stage of 13 plus and 18 plus should be treated as an integral part of secondary level of education - the only distinction being greater emphasis on practical training in vocational courses.
5. Similar divergent opinions are received about the proportion of students to be diverted to Technical/Vocational Education. This proportion varies from 40-80%. In some cases, the figure suggested is as low as 5%.
6. Some authorities feel that it is impracticable to fix a proportion of students for any branch of education and thus make good the shortage of the right type of persons. We cannot create experts out of those who do not possess the necessary intelligence for the work. Forcing students to follow a particular line of education would be against all accepted principles of education.

Extent of proportion, they argue, should depend upon the technical manpower requirements, the aptitudes of the students and also on the resources available.

7. A few are of the opinion that diversification should be in stages. According to them, the first stage of diversification should be at the age of 12 when the child has completed 7 years of elementary education and when potentialities for academic education will be clear. Students scoring below 50% should not be sent for college education.

The next stage should be after Pre-University or pre-degree. At this stage the brightest students should be helped in their college courses.

A third stage of diversification at standard X is also considered necessary by a few others.

8. While many feel that vocational education should be for those who are not intellectually so bright, many others feel this should be based on their parents' economic position. All parents, they argue, whose monthly income is less than Rs 500 should be given vocational training compulsorily.
9. Yet others feel that the practice now in vogue for diversification is all right. The proportion should go on increasing with the technical growth of the country.

Other views received about how this diversification should be effected are :-

10. The practice of diverting students into trade schools merely because they appear unfit for liberal education is unhealthy. Some of the greatest minds in the world have given no indication of their future eminence at the primary stage. While every opportunity should be provided to draw students to vocational training, no pressure should be exerted on them.
 11. Engineering courses should be of a three-tier system:-
 - (a) Trade schools offering certificate courses for those who have completed 7 years primary.
 - (b) Diploma courses in technology for those completing the secondary stage.
 - (c) Degree courses for higher secondary passed. The technical courses at different levels should be workshop-oriented taking into account the modern developments in science and technology and also the needs for a socialistic system of democracy. Teaching of mathematics and science should be strengthened at high school stage.
 12. Diversion to professional and technical courses should not be permitted except at the under-graduate level and not till a student has had sufficient opportunity to test his aptitude and vocalise his ambitions.
 13. 16% of boys and 25% of girls (in 1961-62) studying in standard IV or V did not proceed beyond that class. Wastage between standard V and VIII (in 1960-61) was as high as 70%. It is necessary to plan training courses in crafts of rural industries, agriculture, etc.
- The first channelling of school-leavers should be organised at the end of standard IV or V of primary classes.

Second channelling will be after class X, when students may go for (i) higher general education, (ii) polytechnics, (iii) I.T.Is. However, the entire course upto standard X should be upgraded at least upto the level of the present eleven-year course.

There should be another section attached to the school with diversified curriculum. The section will have parallel classes and the same classification (viz. Standard IX to XI), and follow the curriculum of J.T.S. It is necessary to frame identical courses with commercial, agricultural, Home Economics and Fine Arts subjects. Greater emphasis is to be laid on practical aspect. Academic subjects should also be taught though of a lower standard. The products can go to (i) ITIs, (ii) institutions providing certificate courses in commerce/agriculture etc. or (iii) pre-employment apprenticeship.

A continuation course (longer in duration than the diversified courses but leading to some public examination as at Standard X) should be provided for those who are not able to continue beyond Standard VII but have necessary aptitudes.

Various occupational courses should also be started after standard VII with varying durations.

14. Diversification should be as follows:-

- (a) Into technical stream when selected to higher secondary stage.
- (b) Vocational streams after finishing higher secondary.
- (c) Professional at the level of graduation.

15. Other educationists do not favour the above system of diversification should be at different stages as follows:-

- (a) Four to two years prior to higher secondary (age group 14 to 16) for lines like masons, bakery workers, police constables, watch and ward etc.
- (b) After higher secondary stage (age 17) for technical schools, agricultural schools, medical schools etc.

- c) After passing higher secondary examination for engineering colleges, medical colleges, polytechnics etc.
 - d) After completion of degree course towards Law, Accountancy, Business Management, Journalism, etc.
16. Before diversification, irrespective of the stage at which it is attempted, the students should be taught a number of hobbies over some period. This develops in them a liking for vocational lines.
 17. Number of students in the pre-professional stage should be three to four times than likely to be admitted in professional colleges.
 18. Total period of schooling upto secondary stage should be 12 years. In the last four years provision should be made for compulsory vocational instruction related to local requirements. Skill in craft should be an examination subject. This has not been implemented so far.

Part-time and correspondence courses should be provided for persons in service. Many such persons though bright are unable to take up higher education due to financial reasons.

19. School education should be of 11 years' duration with entry age at 5+. Primary stage should be of 5 years, middle 3 years and secondary school of 3 years. Separate schools with Hindi/Regional language/English as medium of instruction should be opened under each stage with provision for migration from one school to another.
20. A few suggestions are also received that 7 years should be the period of secondary education and diversification should be effected thereafter at the age of 17 years when the boy would be a little mature. Child employment should be prohibited at the age of 13 or 14 unless it be as an apprentice to some trade.
21. At secondary stage, a) General Education schools and b) vocational and technical education schools should be started. All students should be taught essential basic courses in sciences - Mathematics, Physics, Chemistry, Botany, Zoology and Astronomy.

Students should be taken on regular excursion visits to local community projects and should be made to take part in agriculture.

22. Secondary education should be of 4 years' duration leading to either the junior college or vocational training institutions. These technical institutions may be attached to selected secondary schools or colleges and to provide both part-time and full-time courses. They should cater for a very large number of professions, vocations, such as teaching, agriculture, dairy farming, horticulture, nursing, secretarial training, etc. which should be useful for the trainees to enter life. The country is in need of a vast army of such second line professionally trained personnel. For the students who do not pass S.S.L.C. examination, there should be an apprenticeship scheme for practical training at various industrial centres. Cooperation of industries should be enlisted. Both theoretical and practical training should be ensured.
23. For all the students who want to start their professional career after secondary school stage there should be provision for different vocational streams and artisan courses extending over a period of two years. This will enable them to seek employment as artisans or to start their own industrial concerns.
24. Diversification should be effected after higher secondary stage. Students passing this examination should be eligible for all competitive examinations. No extra credit should be given to students receiving a part or the whole of the university education.

II-b) Technical/Vocational Education at School Stage:

1. Technical bias in education should be given at secondary school stage (from 9th standard). Period prior to this should be devoted to general education to avoid specialisation at too early a stage.
2. Present diversified courses in secondary schools do not give necessary preparation for higher technical or vocational studies nor are they job-oriented.
3. In secondary class, there should be diversified groups - technical and science elective groups should be available. Government should concentrate on Technical and Scientific education in Government schools, leaving the education of Humanities to private institutions.
4. Every day science should be a compulsory subject from Grade III to VIII. Instruction should include simple practicals also.

At the secondary level a school should be encouraged to a technical bias but only at the concluding stages should have to make a choice. Sound vocational guidance should be encouraged.

The students' aptitude and interests should be correctly studied before channelising them to different fields. With this done, opportunity would be available to all in their special fields of study. This aspect is given its due importance in foreign countries.

Employment opportunities should also be expanded for persons who thus specialise in different fields.

In addition to institutions in general or liberal education there should be special institutions to serve not only the present needs of the industry, commerce, agriculture, administration, education and other fields but also to accelerate the pace of development in these and related fields.

5. As in Phillipines manual work should be introduced from the earliest standard.
6. Dignity of labour should be taught by making the students compulsorily work during school session, as washerman, sweeper, cobbler, cook etc.
7. There should be a general examination at the end of 9th Standard and two years of professional training should be given to all who do not intend to go up for higher education. This professional training should be given even to the clerical profession.
8. Instead of establishing separate secondary schools for those students who have neither the capacity nor desire to go to higher education, separate stream may be set up in the same schools.
9. Compulsory and elective subjects should be taught only in outlines at the secondary stage.
10. Art Education at Higher Secondary level has to deal with Art as a basic and preparatory subject helpful later for higher education in such professional subjects, as Engineering, Architecture, etc.
11. At middle and high school stage, courses parallel to the academic courses should be developed with a practical bias.
12. Separate technical high schools after 8th standard may be opened or some subjects like engineering, drawing, elements of mechanical and electrical engineering, mechanical technology, workshop practice may be introduced in the syllabi as optional subjects. After matriculation, these students may be given preference in admission to the polytechnics.
13. J.T.S. courses should start after 8th standard to produce skilled workers in trades.
14. Full-time courses for craftsmen may also be conducted to meet the heavy demand for skilled artisans. Courses of two years' duration in carpentry and joinery, fitting, turning, smithy, etc. may be conducted for this purpose.
15. Technical institutes should provide a useful channel to the dull and backward child who may

prove his worth better in industry rather than wasting his energy, time and money in aimless pursuit of the conventional education.

16. Vocational courses of shorter duration may be planned to train larger number of candidates.
17. Courses in technical group should be linked with those in polytechnics.
18. If private organisations open such vocational schools, Government should assist financially.
19. Terminal vocational courses in different trades - as, turning, fitting, carpentry etc. may be conducted in large industrial cities and a few selected towns nearby. Coordinating Boards may be established, on which the representatives of industry be coopted. These Boards should determine the nature of courses, admission capacity, etc. Thus sure of jobs after training, many good students will be attracted to these courses. The formation of these Boards would offset the complaints from industry about the professional competence of I.T.I. and other boys. Publicity measures such as, radio talks, films, newspaper articles etc. can be followed for inculcating a dignity of labour.

II-C) Technical Education at post-matric stage

1. New technical courses should be carefully planned before actual implementation. Local needs and resources should be constantly kept in view. As a pre-requisite, rural industrialisation is very important.
2. After 10-year schooling, there should be Junior Polytechnics of 2-year duration in Engineering, Agriculture, Architecture, Arts & Crafts etc. Bright students should have opportunity to go to higher technical institutions from these junior polytechnics.
3. Number of technical and professional institutions (polytechnics, Engineering colleges) should be increased so that each District has at least one of these.
4. As far as possible, parallel organizations for the same objective and different names should be discontinued. For instance, M.Sc. in Applied Physics of the Faculty of Science would be a duplication of B.E. (Electrical). Diploma from the Indian School of Mines is as good as B.E. in Mining Engineering. Agricultural Engineering is taught in engineering institutions

but agriculture by itself is covered in different institutions.

5. It is very gratifying that the AICTE has provided for the teaching of humanities in Civil, Electrical and Mechanical courses leading to B.E. degree. In fact, such a study should be provided for in all technical institutions including polytechnics, mining schools, etc. or else, technical education tends to narrow down the mind and cramp human feelings.
6. Liberal pre-technical or pre-professional general examination should preferably be continued up to graduate level. Duration of degree course should be 4 years only.
7. The duration of the first degree engineering courses should be reduced to 3 years in the case of diploma-holders, and those who have passed Intermediate or Pre-Engineering or B.Sc. (I Year). Provision should be made to enable diploma-holders also going for AMIE.
8. Engineering and Technological Degree Courses should be of 4 years' duration. Admission requirements for these courses should be B.Sc. or Intermediate. The first year course should be equivalent to B.Sc. in standard.
9. In the fourth year of the course the students should be given 'electives' of which (a) one set should be oriented towards operation and maintenance and (b) another towards research and development. These electives should be in addition to basic quantum of engineering.
10. Degree course in Engineering & Technology should be 5 years. Master's degree should be of 2 years duration.

II-D) Other factors to be kept in view while deciding the pattern of Education

1. Special encouragement should be given to the teaching of technological studies as the immediate expansion of industries depends on exclusive application of science and technology.
2. The limited intake of just 30 students for courses like architecture, telecommunication, mechanical engineering is inadequate, in the present context of technological development. Similarly, specialised courses like metallurgy, ship building, naval architecture, precision instruments should be adequately developed.

3. Special attention should be given to train women in those vocational activities for which they are specially suited. As they have to occupy an important place in national life they should receive all the benefits of education like men.
4. Courses should be so designed to provide an opportunity for earning while learning.
5. Girls should be given special education according to their choice in cookery, painting, handicrafts, child education, etc.
6. Courses should be flexible enough to permit switch over to other courses. if the choice once made is found wrong.
7. Training institutes should be located near big workshops.
8. Technical courses must be really stiff. Weed out persons not coming up to the mark. No relaxation should be shown.
9. Vocational and technical schools should also offer part-time night courses for those dropping out after primary stage.
10. Similarly, part-time evening courses of three years duration may be provided for industrial workers.
11. Management education has to be vigorously expanded in India. This is possible if management education is University-based. The policy of AICTE and its management board in this regard is over-cautious and restricting. It would be suicidal to restrict management education to special interests only. As acknowledged, their intake is very small but the quality of education imparted is not of the desired level.
12. Upto the primary stage, education should necessarily be academic and general diversification should be attempted only at the secondary stage. While one group of persons may come out of secondary stage ready to enter life, another group could be just trained for vocational courses so that they could make good artisans. Yet another group should continue their education. At the under-graduate level there should be diversification again.
13. There should be two public examinations in the school stage - one at the end of elementary stage (after class 8) and the other at the end of secondary stage (after class 11). Students who fail to secure 40% marks shall be diverted to technical and vocational education.

14. For subordinate services diversification should be at Matriculation. For supervisory services at Intermediate level. For poor and handicapped students vocations (like tailoring, carpentry, etc.) may be introduced at the middle school. Extent of diversification would depend upon the industrial policy of the country.
15. Diversification should be at relatively self-complete stages of educational ladder such as primary, middle and higher secondary. Standard of training would vary from stage to stage. Along side the main stream general education, there should be parallel stream of vocational, technical education to correspond to various stages of educational ladder. Necessary link should be established between the two streams.
16. Polytechnic courses should be open to JTS and I.T.I. qualified persons also. Similarly, Diploma-holders should be allowed to study in Degree Courses also.
17. No third-divisioners (or "compartmental candidates") should be admitted for higher education.
18. A minimum schooling of 10 years, though desirable for all, is difficult of achievement in view of the scarce resources. Earlier diversification at 8th standard is therefore desirable with terminal courses imparting adequate trade skills. Such institutions should be developed.

(P.T.O.)

19. Provision should be made for teaching some practical arts for two years irrespective of the courses selected by secondary students. For this purpose, add a small workshop to every school.
20. Even if the technical stream in multi-purpose schools is scrapped, need for proper vocational schools at secondary level still exists. The solution is to modify the Junior Technical Schools.
21. Taking into account the age of children at different stages, job opportunities and minimum prior general education required, a sound system of technical and vocational education could be built around a school pattern of 7+3+2.

Introduction of Crafts and Technical skills at primary stage.

Views received on this subject can be grouped under the following sub-heads:

Feasibility of Introduction of skills:

The replies vary from an emphatic "No" to a conditional acceptance of the introduction of crafts at elementary stage.

Some of the more important arguments received in favour of introduction of crafts are:-

1. Introduction of crafts at this stage would help as an effective aptitude test.
2. It would serve as the first step to meet the heavy demand of technical personnel in the country in course of time, as the right type of atmosphere for promoting technological development would have been created.
3. This helps overcome barrier of prejudice between manual and intellectual work. The child also acquires skill and precision and would ultimately appreciate technical education better.
4. It is possible to impart preliminary knowledge of tools and equipment with a skill having an accuracy

of up to 1/32" to attract children to technical field.

Arguments against.

5. Students are not developed enough to select the crafts. They have limited capacity to understand the technical skills. The skills would thus have very limited value.
6. At the elementary stage, stress should be on pure general education, such as skills of reading, writing and languages, than on teaching a large number of subjects.
7. It would mean overburdening the child with too many subjects.
8. Crafts can be introduced only as a hobby and not as integral part of general education.
9. Crafts can be introduced from middle classes only. Children should be at least 12 years of age.
10. The existing type of activity in primary schools - known as handi work is sufficiently creative to develop the faculties of kiddies.
11. Minimum education should be middle standard but every student from primary onwards should have freedom and facilities to practice any art/craft as a habit or option.
12. Basic crafts involving half the time daily have created disgust for the craft.

Skills at primary stage:

Replies in favour of introduction of skills at primary stage suggest as below:-

13. Only a technical bias should be given at this stage of education. The following can be taught:

Painting, toy making, clay modelling, card board and paper cutting, mechano assembling, working on models of engines, leather work, spinning, weaving, etc.

Working and repairing of gas and oil stoves, bicycles and other household articles, names of screws, carpentry jobs, radio assembling, metal work, fitting, lathe work.

14. Only such crafts suited to local needs and in relation to ordinary needs of living should be taught. Children showing aptitude in particular skills may be drafted for further training.

15. Simple crafts introduced at primary stage should gradually make room for elementary wood craft and metal work. In Higher Secondary schools, craft should be of more advanced type.
16. At elementary stage even manipulative skills, such as, building blocks, assembly of simple mechanisms, simple maintenance techniques as cleaning of cycles etc. should be taught. Some basic tools like knife, saw, chisels can be used under guidance. The objective should be only to introduce the young mind to the realm of crafts.
17. Craft training should not just be nominal but should be real and helpful for more intensive training in the same craft in the post-primary diversification course. Craft training and community activities should develop work habit. Our pupils must learn to work hard and find pleasure in turning out good work.
18. Introduction of art and craft teaching and adopting "learning through doing" principle at primary school level is beneficial. Idea is not to make an artist of a child but to develop the faculty of thinking.
19. For introduction of crafts by stages, a plan similar to that of local New Delhi's Balbhavan crafts education with emphasis on manual training infuses dignity of labour.

At Secondary Level

20. In the first three years of second level of education (12 to 17 +) the programme of first level should be continued. For the next three years the pupils should take up a practical course which is oriented to job training.

After the second level, there should be two types of higher technical course (a) leading to diploma of two years; and (b) Degree of 3-4 years. Courses offered should cover animal husbandry, medicine, nursing, agriculture, forestry, engineering, architecture, etc. Such institutions to have a fair measure of autonomy and closely related to University.
21. A technical bias may be provided in the syllabi of high school classes from 8th standard. Separate technical high schools may be opened.
22. At Higher Secondary stage the school should have good workshops to offer courses - carpentry, blacksmithy etc. Government aid is necessary.

Suggestions for effective introduction of skills

23. Today, in secondary schools, teaching of crafts is a mockery. 95% of the schools are without craft teachers. Further, as no examination is to be taken in this subject, neither the teacher nor the students take it seriously. Teaching of the crafts should not be just nominal but should be real.
24. At K.G. Standard drawing and painting, moulding things, adjusting toys should be developed thus enabling the children to coordinate their head and hands. At primary stage items like paper work, wood work should be introduced.
25. 50% of the marks in the examination should be set apart for the crafts.
26. Equipment should be manufactured in the State factories and workshops and supplied to schools. Special course for technical teachers for primary and middle schools should be conducted.
27. Technical schools should be residential type with workshop practice all through.
28. Crafts can be effectively introduced by providing technically trained staff and adequate grants.
29. In the vacations between terminal examination and the re-opening of the institution, compulsory training should be given in different crafts according to the individual's aptitude.
30. Cutting tools may be introduced even at elementary stage; because:
 - a) through injuries, the children learn to be more cautious.
 - b) proper supervision reduces injuries. This can be achieved through introduction of vocational guidance in every school.
 - c) fear of injury should be got over and the tools gradually introduced.
31. A few others, however, are against the use of cutting tools because of the risk involved. They are definitely against power driven tools being introduced very early in schools.
32. Tool rooms like children's libraries should be introduced at places where there is industrial atmosphere. Boys will be attracted to try their hand at one or the other tool and their aptitude would

be carefully nursed and studied. Thus talent powers should be carefully watched.

33. Teaching of crafts in multi-purpose schools should be compulsory. (Opinion, however, is divided on this issue)
34. Craft and technical education should not be mixed up with education. School education, hobby workshops can be opened in all important centres where students can be admitted for training for two hours per day.

It is better to give job training in concerned workshops with necessary facilities.

35. In rural areas, children can be initiated in agriculture and ancilliary crafts. In the cities crafts should be according to the urban needs. In primary education the main aim should be to teach crafts as a hobby or to utilise it for correlation in the interest of better teaching. In the middle classes (6, 7, 8 standards) the aim should be diagnostic. Craft other than agriculture should also be provided with this end in view.
36. In well-established industrial agricultural units, training should be imparted after secondary education. Wherever facilities exist this could be even during the course of secondary education for two to three days a week according to the nature of the craft.
37. For some jobs like wiring, foundry, weaving, fitting pupils with 8th standard education should be taken into service and on-the-job training given for four years.
38. Craft should be taught in all schools not as activities but as productive occupation.
39. Adoption of audio techniques will be useful. They should also be introduced in subjects like cleanliness, sanitation, hygiene, civic science, etc.
40. Full scope should be given to teachers to conduct new experiments with the help they can receive from the local people for use by the Department of Local Industries.
41. Teachers should be given some acquaintance with these crafts by deputing them for short term courses. For each Taluka, there should be a handicraft teacher - going from school to school, staying in a village for a week, showing what crafts could be possibly introduced.

42. Guidance literature should be made available for the schools.
43. Children should be shown the local craftsmen at work and their works.
44. Annual exhibitions of pupils and teachers work should be held.
45. The Bhingaraj Bal Seva Ashram Vocational School, Kamachha, Varanasi is being run for the benefit of orphans (age-group 6-15), who are taught one or two crafts and are required to make a craft their life profession. The institution considers it necessary to insist upon the services of trained teachers for crafts. Only efficient liberal craftsmen with a good knowledge of Hindi and Arithmetic are stated to meet their requirements.
46. Lessons should contain stories of origin of cycles, motor car etc. On the job training should include theoretical subjects as well and should carry stipends.
47. In Kerala, craft instruction in schools is falling into disrepute, while, all the world over, ever greater importance is being paid to it. This trend should be stopped. Service conditions of craft teachers should be made attractive.
48. In rural areas, introduce crafts like repairs of agricultural tools, blacksmithy, masonry, plumbing. Especially masonry has great potential as large numbers of villagers migrate to cities and masons are in great demand both in cities and villages.
49. Local raw materials should be properly explored and exploited and modern techniques adopted in craft teaching.
50. According to the All-India Council for Secondary Education a craft is to be compulsorily learnt in the higher secondary schools but the syllabus for this is not uniform in all States of the country. Craft training in schools does not serve the intended purpose: (a) as the crafts are taught under unhealthy conditions tending to minimise their importance as an educational medium. It is regarded as an extra subject being useful only for those who are second-rate in intelligence.

(b) Handicrafts are taught in a room devoid of educational associations and are treated as altogether inferior.

(c) Craft teachers are poor in educational qualifications.

(d) Teachers of academic subjects including the Headmaster lack understanding and experience in educational craft. Therefore they are unable to cooperate with the craft teachers.

(e) Craft teachers in secondary schools are ill-paid and classes ill-equipped.

(f) Time allowed to craft teaching is inadequate.

(g) Craft literature based on Indian experiences is lacking.

(h) Proper system for recording, testing and examination of the craft work is lacking.

For overcoming the above defects, standard plans for different schools should be prepared and enforced. Arrangements for regular inspection of craft classes should be made. Diploma holders should be appointed as craft teachers. Differentiation between handicraft teachers and teachers of academic subjects should be removed.

Time allowed for crafts should be increased. For instance, in secondary schools in West Bengal only two periods a week are devoted for craft teaching. This is extremely inadequate. We should devote at least $2\frac{1}{2}$ hours a day and 5 hours a week for the crafts.

51. Open model workshops in schools to acquaint children with names and working of familiar machines like electric press, fans, cycles etc. These machines should be opened up in the presence of children who should have free access to them.
52. Craft work should lay stress on acquisition of saleable skills.

Performance of Junior Technical Schools/
Multipurpose Schools

1. One school of opinion is that the system of J.T.S. is successful in minimising the unusual rush for general education in secondary schools. Even if a boy fails in the final J.T.S. examination he does not feel lost unlike his counterpart in the secondary school. The practical training he has received enables him to get a suitable opening in industry.
2. Even in places where J.T.S. is not working up to the mark, the fault lies not in the scheme of J.T.S. but in its implementation. The J.T.S. could well be the base on which courses in polytechnics and engineering colleges be built, so that the exceptional students desirous of going for higher technical education could be enabled to do so.
3. According to a few others, however, J.T.S. is a total failure. Its products are neither up to the mark in General Education nor in trade skill, so that they are neither acceptable to employers nor fit to go for higher technical studies. They strongly feel that J.T.S. is an unsuccessful duplication of I.T.I. It would be better to take I.T.I. trained candidates from industry and give them further training in industry and also general education.

Suggestions for improvement of the Scheme of Junior Technical Schools.

4. For the recurring and non-recurring expenditure sanctioned strength of 200 in 3 years is too low. This can be raised to 250 without any extra cost or to 360 with very little additional expenditure. Admission capacity can be raised to 120/year and ultimately to 240/year also.
5. The post of a Foreman is necessary to be in charge of practical training in all the shops. Similarly, another skilled workman for maintenance of machines is necessary.
6. A post of clerk may be converted to that of a Librarian.
7. Syllabus for general education is all right. Produce suitable text books. A manual for the practical work should be brought out to ensure a uniform standard in all institutions.

8. Students devote the 1st two years in different shops and specialise in one particular trade in final year. This 12-month training in one trade is not acceptable to employers, as at least 18 months' training is considered necessary. That would save unnecessary apprenticeship periods.
9. Students specialising in Elec. shop in their final year should be permitted to sit for wireman's licence examination. This is not done today on the ground that no training is undergone in a registered Commercial Institute, which is actually inferior to the training in J.T.S.
10. Greater coverage (i.e. 75%) of students for stipends in the final year is necessary. Value could be Rs.20/- p.m.
11. Increase the grant for library. Hostels are not always essential. The sanctioned investment on this item can be reduced. However, the grant sanctioned for the library needs to be increased.
12. Provision should be made for enabling the J.T.S. students to join the polytechnics, Colleges or a 3-year apprenticeship in Industry.
13. The scheme of J.T.S. should be modified as follows :

Humanities & Languages	532 hrs. (H.S. Standard)	
Science & Mathematics	740)	
Elec. Mech! & Elec. Engg.	250)	(Equivalent to
Engg. Drawing	300)	1st year of
		Diploma course)
Workshop Training	2000.	(Equivalent to
		1 year of I.T.I)
- With this modification, the students would be suitable to join industry and apprenticeship scheme or join second year or polytechnic or Engineering College by joining pre-engineering course.
14. As for I.T.Is. 6 month in-plant training should be adequate for J.T.S. boys.
15. I.T.Is., J.T.S.; and Apprenticeship Schools should be merged into a single scheme to produce operatives.
16. The Junior Technical School course should be considered equivalent to S.S.L.C.

17. J.T.S. can be successful only when effective liaison with industry is established. A change in the system of instructions is also very necessary. This scheme of J.T.S. is preferable to I.T.Is. in view of the element of general education imparted.
18. Until such time as school education can be provided for all, JTS and Industrial schools may continued and students completing first three years of second level of education (12-17+) may be admitted. The programme of such schools should be brought in line with that of regular secondary schools but with greater provision for and emphasis on the practical subjects under "elective".

Multi-purpose Schools

19. At present, the syllabus for standard XI of Multipurpose schools is the same as for any other purely academic high schools. When provision is made for choosing some technical subject for SSLC along with the core subjects, it is necessary to provide for continuing that subject in the syllabus of standard XI in multipurpose high schools with technical bias. The same continuity should be in pre-professional class also. At present, pre-professional is nothing but Inter Science class in a Science College. If continuity is maintained in teaching technical subjects from SSLC to engineering course, efficiency will increase. Boys passing standard XI from Multipurpose schools with technical subjects should be preferred for selection to pre-professional class in engineering.
20. The main cause for the failure of Multipurpose schools is the lack of preference to students of these schools for admission to polytechnics and Engineering Colleges. No course can be terminal in any scheme of education, as the process of education is itself continuous and should provide avenues for further advancements and achievements in learning.
21. In some institutions, far from giving preference to these students, they are not even entertained to the Science course of 3-year degree colleges, on the ground that the syllabus in physics and chemistry is below the expected standard. If admitted at all, they have to take a preparatory exam. in physics and chemistry. Either this handicap should be removed or the stream itself abolished. Similarly, the stream of Fine Arts is not successful, as further scope is limited.

22. There should be separate vocational schools instead of multipurpose schools because (a) no sound vocational and technical education can be given unless with a weak grounding of science, mathematics and languages. (b) crafts in higher secondary and multipurpose schools do not carry prestige vis-a-vis a curriculum leading to collegiate education of higher market value. Result is that nobody in schools takes a craft for the purpose of living and rush to colleges is not minimised leading to great wastage.
23. Mere introduction of vocational subjects in Higher Secondary schools serves no purpose. Instead more of vocational schools of a Higher grade are required. General education should continue to form an important element in these schools.
24. In rural areas where students have to come from long distance, school holidays should conform to the rural conditions. Hostel facilities are very necessary. More such M.P. schools should be located in rural areas.
25. According to a few, Multipurpose schools can be reorganised as follows :-

In technical wings of multipurpose schools, quantum of general education should be reduced and the technical content correspondingly increased so that, it could become a real terminal stage.
26. As an alternative, the technical education at this level should be only exploratory in nature. This should be the outlook of multipurpose schools if Junior Technical Schools are continued as separate units. In such a case, the technical education should be in place of present crafts and should be compulsory for all students.
27. The main reason for the poor quality of students coming out of multipurpose schools is lack of properly trained staff. This could be overcome by offering better scales of pay.
28. Heads of multipurpose schools should be technical persons.
29. It is found that the duller boys are relegated to the technical stream.
30. Detailed statistical studies should be made to ascertain how the products of technical streams are faring in different courses of studies they have undergone. Such a study would reveal the failure of such streams.

31. Craft instruction in ordinary schools is unpopular because: (a) only one period (30-40 minutes) a day is devoted to crafts; (b) in some places, grant is ridiculously low i.e. 50 paise per student per month for raw materials. (c) Lack of tools, (d) No examination is held in crafts, (e) Inefficient teachers are appointed. (f) Inadequate supervision.
32. A few authorities feel that the recommendation of secondary education Commission to introduce craft as a compulsory subject in the core programme and to diversify courses at Secondary stage was not given a fair trial. The scheme was not fully worked out and was introduced in a hurry without proper equipment, tools, grants for raw materials, trained teachers etc. and has therefore become unpopular.
33. Under the scheme of J.T.S., students are to work for 40 hours a week continuously for 40 weeks a year. The strain is too much considering the age group of 14-17 of the students.
34. Increase the duration of J.T.S. to 4 years so that technical skill attained is equal to that of I.T.I. and academic skill equivalent to 10th standard.
35. I.T.I. cannot meet even 1/5th of country's requirements of skilled workers in 4th Plan. J.T.S. should, therefore, continue suitably modified.

36. In some industries, J.T.S. boys are preferred to I.T.I. trainees.
37. Production centres should be attached to the various Junior Technical Schools after removal of difficulties in the encountered disposal of articles.

Working of I.T.Is/Apprenticeship Scheme

1. I.T.Is. are, on the whole, working satisfactorily. However, better results are possible by increasing the practical content and allow^{ing} the trainees to handle the equipment as much as possible.
2. Training should be trade-wise and schools should be attached to responsible industrial plants/factories both in the Public and private sectors.
3. Better co-ordination between technical institutes and factories necessary.
4. The method of selection of students to I.T.Is. should be improved. To-day it is not based on merit and aptitude only. Many other extraneous factors come to prevail.
5. I.T.Is. give only minimum training in some selected industrial and technical subjects and turn out half-skilled artisans. The training is not complete and products have no scope of higher training anywhere. Higher standards of training are necessary.
6. Modern equipment should be provided to I.T.Is. and marketing society set up to buy the products of I.T.Is.

7. In an industrially advanced society even unskilled workers need to have the background of general education that develops their receptivity, power of understanding, alertness, responsible behaviour, job-satisfaction.

The skilled operatives should know not only the specialised skills but the processes involved. For this, the approach should be rational and integrated.

All jobs in the industries must be clearly classified, titled and described. This must be periodically reviewed. All Industries in private and public sectors must be required to have their job designations in conformity with this standardised list. Further, a census of all types of jobs - both filled and vacant should be prepared. While estimating manpower requirements, job-wise demand schedules should be prepared.

8. Provision of industrial training facilities should be geared to both the numerical and qualitative needs of industries in all categories of jobs. Careful planning necessary to avoid surpluses in any field.
9. I.T.I. training is a little out of date, as it does not keep pace with changing technology. Some improvements are now coming in, in the form of providing more of general science and better facilities for related instructions by providing guest lecturers. Greater educational bias is necessary.
10. After 18 months of training in I.T.I. the trainees were to get 6 months of in-plant training but they were not acceptable to employers. The scheme is now being recast increasing I.T.I. duration to 2 years. This change was very necessary.
11. On-the-job training should be guided and well-supervised. The operations arranged should have logical sequences. Enough time should be allowed on each operation to acquire requisite skill and speed.
12. In formulating the training programmes in I.T.Is, industry should be associated to a much larger extent. Job opportunities should also be kept in view.
13. The number of I.T.Is. should be increased. Their revenue should be supplemented by providing commercial articles.
14. Minimum admission qualification should be Matriculation.

15. Examiners should be from other institutions. At present, very often examiners are appointed to different trades in which they are totally inexperienced.
16. I.T.I. products should be eligible for admission to polytechnics or engineering colleges for a condensed course to improve their qualifications.
17. Working hours should be reduced to 30 hours a week instead of 42 hours, out of which 15 hours a week should be for theory.
18. Timely supply of raw materials and better equipment should be ensured.
19. Instructional staff should be promoted on the basis of merit only. Their grades of pay and other conditions of service should be improved.
20. In senior positions highly qualified and well-paid staff should be appointed.
21. Instructions in I.T.Is are more theoretical than practical.
22. Only III class students should be admitted to I.T.Is
23. There should be greater coverage of trainees by stipends.
24. There should be better coordination among I.T.Is., educational institutions and industries.
25. Technical schools/Institutes should not live in isolation from Industrial areas.
26. Educational Inclaves should be set up at different places particularly for post-secondary stage, to which industries should be attached and the students should compulsorily be made to work 2 to 4 hours daily in these industries. Thereby the cost to the management is nil but benefits are considerable.
27. Minimum admission age to I.T.I. is 16 years while for most of the trades, the students would be fulfilling the required academic qualifications (i.e. 8th standard) by 14+. The candidates are thus to wait for two years for securing admission to an I.T.I.
28. I.T.I. sessions do not start with the same time as school sessions. This should be suitably adjusted.

29. The minimum admission age to I.T.I. is 16 years while boys normally complete the required academic qualification at 14+. Admission should be adjusted to stop this forced waiting period of two years.
30. I.T.I. should be the main channel for craftsmen training, specially for certain trades as electronics and instrumentations.
31. 18 months training in I.T.I. is inadequate to provide a strong basis of trade skills. Period should be increased to two years in certain trades supplemented by 6 to 12 months of on-the-job training.

Working of the Apprenticeship Scheme

1. Apprenticeship scheme is very useful, though it is now passing through some teething troubles. The promotional programme should be strengthened through the present set-up of advisers. Greater returns could be expected if the industry is made to appreciate the need for sound training of the apprentices. That would avoid the situation of posting the trainees under compulsion.
2. Apprenticeship Act 1961 leaves very little scope for on the job training for unskilled and semi-skilled workers. Various industrial and Government undertakings train up workers for certain specialised operations. It is preferable to have training schemes as provided in the Act. In principle all apprenticeship should be accepted as a compulsory method and the integral part of any workshop.
3. The Act serves only immediate purpose but it narrows down the scope for the apprentices. The syllabus needs revision to provide for more scientific and engineering knowledge besides technical skills.
4. Many industries do not provide wholehearted facilities for apprenticeship training. Frequent inspection necessary. Residential facilities and adequate allowances should be given.
5. Some quarters hold an extreme view that the Apprenticeship System should be abolished and that, instead the training should be conducted in the Institute itself.

6. A few others however feel that it would be adequate if the general impression that the Apprenticeship Act produces men for lower service only is removed.
7. Under Apprenticeship Act, every factory is compelled to train a given number of trainees, depending on number of skilled craftsmen on rolls. However, the number of apprenticeships in each trade in a given factory is small. In a survey of 8 fairly large factories done in Bombay, the number did not exceed 8 or 10 when all factories were pooled and only 1 or 2 apprentices when each factory was considered separately. The factories are required to employ an instructor for these 1 or 2 persons only, while the number that he can easily handle is 16-20. Acute shortage of trained instructors is being experienced. This is all the more so in rural areas.
8. Inter-State arrangements are necessary to overcome the difficulty in securing apprenticeship training where industries involving costly equipment are limited in number.
9. It is necessary that a sense of participation by the industry and a sense of belonging in the minds of apprentices should be brought about by organising the training programme by cooperative effort of the three partners in the scheme viz. Government, Industry and educational institutions. The idea must be sold.

Apprenticeship Adviser must have powers to sign the contract of trainees, fixing number of persons to be trained in a particular trade, etc.

On-the-job Training

More intensive on-the-job training is stressed in a large number of the replies. A few persons, however, feel that the present apprenticeship training is adequate.

Some of the more important suggestions received in this connection are given below:

- 1) Technical training imparted should not be aimed only for securing any government or private job. It should be more to give the trainees enough confidence to start private business and earn their livelihood.

2) Training should be mainly in works involving more of manual skill than theory and also where quick decision is called for. Unskilled worker should be trained on the operational side and semi-skilled worker on the technicalities of the job.

3) VIII standard students can be termed as unskilled workers, I.T.I. as semi-skilled workers. A 2/4 months training on the actual job is necessary before they are put on actual production. Annual State wide requirements should be calculated and trainees admitted accordingly.

4) Theoretical instructions regarding the job concerned are equally essential to understand the merits and demerits of the work.

5) Training should liberally make use of audio-visual aids - as slides, films, etc.

6) Part-time evening classes should be arranged for unskilled and semi-skilled to make them skilled.

7) Syllabus prescribed under the Apprenticeship Act for providing short-term and full-term training is sufficient. This should be followed by periodical refresher courses.

Present system in the Government and private firms is adequate for on-the-job training for unskilled and semi-skilled workers.

8) Training should be only in those jobs which the trainees will be called upon to do later, or in which the person has shown some aptitude. This is the quickest way of training the operatives. The training should be at least for a minimum duration of 2 hours per day during the trainees' off duty hours subject to a minimum of 40 hours/month. The total duration of training will vary with the trades and can be anywhere between 320 hours and 960 hours depending on the nature and degree of skill to be attained.

9) A few others feel that the on-the-job training should involve rotation of the trainees in different trades, or should be covered in a vestibule training centre attached to each factory.

10) Yet others feel that before the workers are put on on-the-job training, a well-organized basic training of about 30 - 40 weeks is very necessary. The on-the-job training which follows should take the form of gradual replacement of regular workers by the trainees. This period of transition may take about one or two weeks.

11) The unskilled worker usually requires general education as well as craft skills. Evening classes for two days in a week would be necessary.

12) General education should be provided along with education in trade unionism, Civics, Sociology and a knowledge of the world around, with special emphasis on the particular craft/trade. This induction course in Sociology and skill for unskilled worker over a period of 3 months and for semi-skilled worker over 6 months is necessary.

13) All unskilled/semi-skilled workers can make good skilled men. Only selected persons should be given special apprenticeship training.

14) Short-term courses in different trades should be arranged in the I.T.Is or junior technical schools.

Some members have suggested that the duration of this course may even be one or two years.

15) Under study method of training may be given to the unskilled and semi-skilled workers under regular production employees.

16) Compulsory apprenticeship training should be arranged with the industries.

Regarding qualifications and other conditions of admission and content of various training courses at different levels, the following main suggestions are received:-

17) Skilled Worker:

a) 8th pass will do but should have undergone three years' course in any craft.

b) Should possess an I.T.I. Certificate after SSLC and with necessary in-plant training, the duration of which will depend on the extent of skill to be attained.

c) In addition to good professional skill in his particular trade, the skilled worker should have reasonable skill in other trades also.

d) In the training programmes for the skilled worker, there should be 80% practical work and 20% of humanities and theory. Practical exercises should be on components of a machine or any other useful article to develop a trainees' interest.

e) General Education suffers from the standard of English. Either the standard should be raised or the medium of instruction should be changed.

f) While deciding about the general and specialised education, we should keep in view the different types of jobs in industry performed by the respective categories of technical personnel.

g) We should remember that a skilled worker aspires to be a foreman, supervisor, etc., in the course of time. His education must, therefore, contain items of basic knowledge such as shop mathematics, drawing, measurements etc.

The education of these persons will naturally centre round the knowledge of technology required in each case. For example, a welder must be given, in addition to the basic technology, a theoretical education in welding technology, materials involved, temperature, etc. We should make him understand and appreciate his work.

h) Educational preparation for skilled worker is covered by the Apprenticeship Act, but it is better according to a few, that SSLC is the minimum qualification for entry into a skilled trade.

i) Some stray suggestions that a skilled worker need not have any general education at all and that mere trade skill would serve the purpose, are also received.

j) Training of the skilled worker should make liberal use of visual aids, like films, slides, demonstrations and museums.

k) If the skilled worker cannot study up to 8th standard, there should be provision for day-release or part-time education in a nearby institution.

18) Foreman

a) General Education up to SSLC followed by Diploma in technical education should be the minimum qualification. Practical experience of one year should form part of Diploma Course. The aspirant should have at least 5-10 years' experience as skilled worker.

b) The training programmes for the foreman may lay slightly reduced emphasis on practical training compared to the skilled workers. While for skilled workers 80% practical work is necessary, 50% would do in the case of foreman.

c) A foreman should necessarily have taken Physics, Chemistry and Mathematics in his High School.

d) The present method of instructions in Polytechnics should be re-oriented, bringing in more practical experience. Longer in-plant training is necessary.

e) A few members seem to feel that general education up to 8th standard will do for foreman and that what is more important is depth in trade skill with knowledge of engineering fundamentals.

The foreman should have good professional skill in allied trades also.

f) Posts of foremen should generally be filled up by promotion from among skilled craftsmen after they have undergone a part-time course.

19) Technicians

a) Foremen and Technicians should be considered as one category. In both the cases, general education should be SSLC. It is only after entering industry, they need specialisation.

b) The Syllabus for the training of both foremen and technicians should include personnel management.

c) For technicians, there should be more liberal general education which may go up to 40% of the total period.

d) Technicians fall into two categories

(i) Production technicians, and

(ii) Demonstration technicians.

While the first category would be doing designs, plans, determining quality control and would be cost-conscious, the second category would be engaged in costing, estimating, personnel management, etc. for both these categories, 3 years' of training after High School is necessary.

20) Engineers

a) There should be two streams of engineers: (a) Science-oriented; (b) technology-oriented. The former should be given an intensive

course in the theoretical aspect of engineering. For the latter, the emphasis will be on the practical aspect of engineering while knowledge of basic sciences and also working skill will not be neglected. We should recognise the difference between training and education. Training makes one competent to execute a job while education makes him inquisitive and enables him to rise higher. Education should not lead to a blind alley.

b) The engineers' education must be science-based. The present engineering colleges are adequate if they are slightly re-oriented. Specialisation should come after general engineering education and the quantum will depend on the State of Development and requirement of industry.

c) For graduate engineers, specialisation in the following items would be necessary, after their entry into industry:

(i) Industrial relations and personnel management;

(ii) Store keeping, order & shipping; etc.

d) Minimum general education for an Engineer should be over 12 years.

e) Engineer should necessarily have a degree.

General

a) General & Specialised education for any category of technical personnel should be in accordance with the jobs they are expected to do.

b) According to a few persons, General Education and Specialised education components could be as under:

	<u>General Education</u>	<u>Specialised Education</u>
Skilled worker	7 years	1 year
Foreman	10 years	3 years
Technician	10 years	2 years
Engineer	11-12 years	5 years

c) According to many sandwich courses are the best answer for preparing the different categories of technical personnel.

Cottage Industries/Small-scale Industries

21) Though unassuming in externals, cottage industry has a far-reaching effect on Indian economy. The work is mainly executed by hand but use of modern tools and techniques is no taboo. Products have a marked individuality and an aesthetic quality which is absent from machine-made goods.

22) Cottage industry is complementary to and an essential adjunct of large and small scale industries. This should not be left to illiterates or poor persons only. Benefits of modern science and technology and latest tools in techniques must be extended to this field.

23) Dearth of skilled workers is one great handicap facing this industry. Plenty of human and material resources on the one hand and acute shortage of skilled labour on the other looks like a paradox. This can be solved through (i) careful planning that has taken into consideration our social and economic aims and (ii) proper training and right placement. The employment exchanges should be of much greater service in this regard, by maintaining a regular contact not only with the employers and applicants but with vocational training schools and other institutions.

24) The possibilities of over-production or inadequate demand can be obviated by introduction of new designs, improved tools and techniques which are available through constant research.

25) The training schools all over the country should have uniform standards in respect of objectives, contents, examinations leading to the award of certificates, etc. The different courses should be uniformly classified. A trade bulletin setting out details of all the training courses should be brought out.

26) In Silpa-Bhavana at Santiniketan concerted efforts are made in carrying out a total programme of re-construction by taking an integrated view of village life and imparting health education, industry education and other allied useful subjects. It concentrates on some selected promising industries, conducts research for better designs, improved tools and techniques and imparts training to villagers who are finally rehabilitated in their own settings. Similar institutions are required all over the country.

27) Training Institutions should be established for imparting the know-how of small-scale industries and handicraft.

Polytechnics

1. There is a big gap between the actual outturn of technical personnel and their utilisation. This is all the more so at diploma level. Instances of hundreds of qualified persons applying for each vacant post are not rare.
2. The present syllabus is a crude attempt to squeeze the entire syllabus of degree courses. Actual job requirements are not catered for.

The syllabus is framed with a view to securing studentship of Institution of Engineering. This should be recast retaining only the essentials of science and mathematics. While recasting the syllabus adequate accent should be laid on practical side. This emphasis on the courses being more practical biased, should not be constructed to mean mere craftsmen level of work. Training must be on the production and construction methods and techniques.

3. To deliver the goods, the polytechnic courses should be technology-based, the laboratory exercises being aimed towards practical applications, namely dismantling, organised testing, location of parts, etc.
4. Thick sandwich type of training alternating between shops and schools should produce the requisite grade of supervisory personnel.
5. It is suggested that each polytechnic should have a few industrial concerns to support them for their practical training. The students should be encouraged to spend their vacations in workshop under the charge of a lecturer for planned training.

6. Staff should have refresher courses in industry.
 7. Adequate practical bias and confidence in work cannot be imparted in a duration of three years. The duration should, therefore, be increased to four years. A large number of electives should be given in different institutions according to the availability of basic facilities.
 8. A few others, however, hold a contrary view regarding the duration. According to them, all technical courses such as electrical, mechanical, nursing, etc. should be of two years duration only instead of three years after the secondary stage. The one year thus cut down should be added on to the secondary stage of education reducing the cost of professional education.
 9. The syllabus may be changed to prepare technicians and engineers, for a specified type of work deleting unnecessary subjects, for instance, there is no point asking the civil engineer student to learn about heat engines or a mechanical engineer to learn surveying. This time could be usefully spent in polytechnic or factory, so that the students know the practical application of their theoretical training. With this arrangement it is possible even to double the admissions to the polytechnics and engineering colleges.
 10. The growing needs due to 5-year plans for skilled and semi-skilled workers have to be met by special institutions which should run diploma courses in specific technical and professional subjects. General courses (such as, Civil, Electrical, Mechanical Engineering) should be replaced by Diploma in Automobiles, Refrigeration, Building Construction, Irrigation, etc.
 11. According to a few others, courses in mechanical draftsmanship, civil draftsmanship and estimating, sub-overseers or building supervisors' course should also be started.
 12. As more than 50% of diploma holders have to view work in rural areas, it is necessary that adequate rural orientation should be given to the trainees in polytechnics. Training should include rural housing, sanitation, and water supply. This rural orientation should be final.
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- be an integral part of the curricula in polytechnics.
13. Training in polytechnics should be of two categories:
 - (a) Training useful for urban area.
 - (b) Training for rural area.
 14. Requisite practical training to polytechnic students could be arranged as follows:
 - a) Create at least 500 seats in the various industries and send the students to these industries in rotation for a period of two months during the first or second semester according to a pre-arranged programme. In this way about 3,000 students can be provided practical training per year. (intensive practical training though just for two months will still be beneficial).
 - b) As an alternative works in polytechnics should be removed and converted to aonal training schools. Each workshop in a polytechnic normally can accomodate 120 students and the 17 polytechnics in Madhya Pradesh, for instance, can thus provide training facilities for 2,000 students at a time. If one semester is allowed for practical training, about 4,000 could be trained every year over a period of 1200 hours each against the present training period of hardly 500 hours in polytechnics.
 15. Part-time courses of four year duration should be r un for those engaged in any particular branch of Engineering.
 16. Each district to have a polytechnic, the strength of which should be limited to about 180. If demand is more, two polytechnics should be established. In larger institutions it is just mass production of diploma holders without any quality.

17. Fall in standards of polytechnics is due to shortage of qualified teachers, insufficient use of audio visual aids, inadequate practical experience, selection of candidates though without aptitudes. Besides these the curriculum of studies lacks the practical approach to the subjects, the syllabi being vague and theoretical.
18. Only talented students should be admitted to polytechnics. 50% of seats should be filled up on merit and the rest by competition in drawing, report-writing and Mathematics. Aptitude tests also would be useful. Minimum qualification should be Higher Secondary.
19. Many items of equipment in polytechnics imported from abroad are used for only a few hours a week. Examples are universal testing machine (Rs. 40,000), boiler (Rs. 1.2 lakhs), steam engine (30,000). Possibilities of pooling the resources of adjoining institutions for giving necessary training should be fully explored. Further, equipments needed at least for the diploma courses should be manufactured in our country.
20. Instead of opening new institutions, the existing ones should be better equipped. This would facilitate their working in two shifts.
21. Especially at polytechnics, no sophisticated equipment is necessary. Indigeneous equipment should do.
22. The total enrolment in polytechnics should be limited to 150 for single shift.
23. For the benefit of teachers, frequent organisation of seminars, award of prize for the best original teaching, frequent inspections, arranging lecturers from experts would be useful.

24. A four pronged attack is necessary to remove the defects in polytechnics. (a) polytechnic teachers should be carefully selected without placing undue emphasis on the fact whether or not first Division was obtained by the student in the final examination. Vigorous and dynamic approach should be made for recruiting talented teachers and provision made to pay them handsomely. Their salary should be comparable to any other service. (b) obsolete teaching techniques should be done away with. Teaching aids should be developed on teachers' initiative such as classroom charts and models. Each institution should have facilities of dark rooms, film strips, projectors, etc.
25. Exchange of personnel between industry and polytechnics is necessary. Recasting of the curricula should be done in collaboration with the industry.
26. Medium of instruction may be vernacular, with English technical terms retained.
27. A scheme of specialised diploma should be started in particular trades as welding, sheet metal work etc.
28. Possibilities of insisting on prior industrial training before admission to polytechnics (as in Germany) may be considered.
29. To-day, polytechnics courses are limited mostly to three main disciplines of Civil, Electrical and Medical. They need to be diversified to include other discipline as metallurgy, electronics, instrumentation, chemical engineering and also other courses such as secretarial, commercial, agricultural to make the polytechnics real centres of vocational education.
30. Courses should not be fully job-oriented. Admission age should be 16 years.
31. Polytechnic course should include subjects like industrial psychology, labour management.
32. A certain percentage of admission to polytechnics should be reserved for craftsmen sponsored by industry. This will avoid duplication of training facilities.

33. Some planning and executive posts should be reserved for diploma holders securing higher qualifications as AMIE etc. and have gained sufficient experience.
34. Standard of polytechnics should, in no way, be diluted by admitting students after X standard. If such admission is at all necessary, duration of the Diploma course should be 4 years.
35. Diploma holders should have some practical experience before being admitted to AMIE.
36. Polytechnics should come up only in places of industrial complex.

First Degree Courses in Engineering

1. Technological developments are growing at an exponential rate every day. The vacuum tube has given way to solid state device, piston engine to jet, rocket, conventional power to atomic nuclear power and rotating generators to plasma and fuel cells.

To cope with these rapid changes, immediate changes in curriculum, methods of teaching and learning are necessary. A high power committee should draft skeleton courses for entire country, which should be revised every 3 years.

2. The standards of technical education do not compare favourably with those of advanced countries. To raise the standard only gifted and hard-working students should be admitted to the courses. The professional training of engineers should have a background of general education to make them responsible citizens. It should be carefully examined how far it is practicable and desirable to include in the curricula, the unprecedented technological developments taking place every day around us. Hasty and incomplete study of fundamental concepts lead to confusion

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while dealing with larger specific problems. Today there is a tendency to introduce more advanced subjects into the curriculum at the sacrifice of fundamental concepts. If courses of study are much more than what a student can understand intelligently and assimilate, it would be futile to expect him to be up to the mark in any aspect. Instead of too much details in each subject we should concentrate on the corresponding fundamental subjects like fluid mechanics, thermodynamics, heat transfer etc. A few authorities, however, strongly believe that the existing arrangements are satisfactory. If at all required some changes may be made to suit localities and environments.

3. A majority, however, feel that the degree courses call for a lot of changes. According to them, course-patterns are not laid down in relation to future competency requirements. Teachers, therefore, become static and the students are never enthusiastic. The course contents should be so designed as to avoid duplication and gaps in the different professional institutes.
4. Courses should be of a slightly more specialised nature, so that the period of in-plant training could be cut down. This calls for good coordination with industry and accurate estimates of manpower requirements. Syllabus should be suitably recast.
5. Besides conventional under-graduate courses in civil, electrical, mechanical, mining, metallurgy and chemical engineering, architecture, town planning and tele-communication we should add also Nuclear Physics and Reactor Technology, industrial research and development, science museums and laboratories, instruments technology and watch-making, etc.
6. If students are deficient in modern theories, mere refresher courses will not help. These latest theories should be taught and included in the All-India competitive examinations. Unnecessary subjects for any branch of profession (such as Civil Engineering subjects for Telecommunication Engineering) should be weeded out.

7. Syllabus in Engineering Colleges and polytechnics should be uniform all over the country with a Central examining body. Honours course (one year after General course) should be introduced for specialisation.
8. The curricula of studies for the 5-year integrated course evolved by AICTE and Inter-University Board should be tried for some more time before making any change.
9. Curriculum should cover wide-range of subjects including local industries.
10. Curriculum should be periodically revised. Technical teachers should maintain constant touch with industry and research agencies.
11. Many educationists feel that any rigid uniformity among different institutions in academic matters would kill their initiative. It is, therefore, felt that these institutions should have reasonable academic freedom to develop according to their own genius.
12. Two methods of teaching have gained currency - project method and problem method. In the problem method a specific and well-defined problem is given to the students for solving while in the project method a whole project is set for finding out relevant details and submission of report. While the problem method is simple to organize and practicable even for large institutions it does not develop sufficient faculty of original thinking. But the project method is difficult to organize in large institutions. Teaching should therefore include at least a limited amount of project work depending upon the facilities available.
13. Technical bias should be introduced from secondary level so that at colleges specialised training should be given.
14. Engineering Colleges should have strong Science Departments and present syllabus in Mathematics, Physics and Chemistry should be upgraded to develop the faculty of thinking. Methods of teaching must be modernised. New text books produced by institutions like M.I.T. may be used.

15. Special emphasis should be laid on learning of science through practical work, so that the student could apply the principles learnt usefully. At present there is a lack of this appreciation of principles. If high school education cannot be improved in this manner the students should have two or three years of college education in arts and science. In the under-graduate course learning should be through observation, experiments and not merely learning things by memory.
16. Full-fledged science Departments should be established in all Engineering Colleges to realise the full impact of science on technology. In pursuance of the recommendations of Thacker Committee, these departments should be allowed to have post-graduate courses. Strong post-graduate departments are our most urgent requirements.
17. Graduate engineers should preferably be trained from 1st class degree holders in fundamental science. 3-year degree course for science graduates should be the normal pattern.
18. Duration of degree should be only three years. In Engineering fundamentals like engineering, mathematics, Physics, Chemistry, electricity, hydrolysis etc. only should be /taught. Specialised subjects like Railway Engineering, Docks and Harbour Engineering need not be taught as Railways and Docks train their own engineers. After all, all engineering graduates need post-degree training. This reduction in duration will not, therefore, materially matter.

It is not very essential to teach Humanities in engineering courses.

19. Duplication of training programmes should be avoided. For instance, when Railways train their own Mechanical Engineers, the School for Mechanical Engineers appears to be a costly duplication.
20. There is no homogeneity in the degree awarded by different universities. They are differently known as B.E. (Calcutta, Bombay, Madras universities) B.Sc.(Tech.), B.Sc. (Engineering), B.C.E., B.M.E., B.E. etc. Certain engineering colleges cover their curriculum in less than five years. This discrepancy should be discontinued.
21. The award of comparable title by non-academic institutions should also be considered. To-day there are more than 40,000 students on the role of Institution of Engineers preparing for graduateship. There is no limit on this number. This factor should be taken into account while estimating our technical manpower requirements. In addition to Institution of Engineers there are many other organisations though not recognised by the Government. A regular course of study in an engineering college offers much better background in the engineering career than in Associate Membership certificate of a non-academic institution. Government should consider the justification for equating these two for purposes of giving jobs.

The system of awarding comparable titles should be stopped and universities should admit external students to study for the degree examination. In U.K. 50% of engineers are external graduates.

22. Universities should undertake research on various problems on business. Universities should also be asked to institute diplomas in addition to regular post-graduate courses.

23. Master's courses in Engineering should have sufficient practical bias and diverted to specific problems of Industry.
24. Every college of good standing should start post-graduate courses in fields for which facilities exist.
25. Research will get a fillip if you get more students for post-graduate studies with definite problems in their minds and a good practical background. At present all students go straight from degree to post-graduate classes without any practical background. This is waste of efforts.
26. The I.T.I.s and the Indian Institute of Science, Bangalore, which enjoy university status should cater for
 - (a) Developing researches
 - (b) Refresher course for teachers in engineering institutions;
 - (c) Provide technical personnel in industries with necessary theoretical background.
27. Class work should be in the form of Seminars, and discussions about assignment. Students must be made study-minded.
28. In some institutions in Kerala number of working hours per week is 39 at the rate of $6\frac{1}{2}$ hours per day for 6 days. This leaves the student no time to assimilate what he has been taught in the class-room. The work-load should be reduced to $6\frac{1}{2}$ hours per day for 5 days per week only so that thinking youngmen equipped with fundamental concepts of engineering and with confidence to face problems are produced.
29. Admission to engineering courses should be primarily for higher secondary boys. A small number of diploma students may be admitted to second year class. J.T.S. students should also be eligible for admission after doing a pre-engineering course.
30. Pre-entry exposure to industry, somewhat on the German practice, would be desirable.
31. Students should be permitted to take technical courses after qualifying in the Higher Secondary examination. However, if a student has not gained a good insight into science, it is necessary, as in the United States, that College education for a couple of years should be a pre-requisite before

taking up vocational courses.

32. According to some educationists, two separate courses (viz. technology-oriented and science-oriented courses) should be introduced at first degree level of engineering. Admission could be in the ratio of 80:20. It is argued that majority of the engineering graduates take up mainly production and maintenance and as such a very high standard of basic sciences or of engineering principles would not be required in their cases.
33. While text-books for technical schools should be published in regional language they should be the same or of the same standard throughout the country.
34. I.I.Ts should preferably act as design and research centres for Industries. These and similar higher institutions of technology should aim at production of Senior Engineers.
35. The standard of education in engineering colleges has been steadily going down. The employers are dissatisfied with the engineering graduates coming out of the institutions. This downward trend is due to:
 - (a) Inadequate preparation of the student at the higher secondary level in Physics, Chemistry, Mathematics and English.
 - (b) Shortage of qualified teachers and inadequate equipment consequent upon rapid expansion of institutions.
 - (c) Lack of equipment, laboratories and workshop leading to inadequate practical training.
 - (d) Lack of interest and support by the industry to provide necessary practical training.

As a result, the courses are too theoretical and the products not acceptable to the employers. Brighter employment opportunities have reduced competition at college amongst the students. Further, as the teachers are not effectively represented in the University Councils, the syllabi/schemes of examination etc. are still often obsolete.

36. Technical education should include actual practical work at every level. The type of technical education prevailing in National Defence Academy, Khadakvasla should be a model.

37. Practical training of one year at the end of the course should be re-introduced. According to some educationists, the practice of spreading the period of practical training over all the vacations serves no purpose at all. Such training should commence only from the Third vacation when the students would have gained some back-ground of engineering subjects. The general practical training schemes of the Government are not useful as students rarely get employment in the same establishment where they undergo training.

Without adequate supervision, any such training would be a farce. Today there is practically no facility for coordination between Industry and Educational Institutions.

38. Industrial training after graduation should be a compulsory qualification for entering university post-graduate engineering departments.
39. It should be made obligatory on all the engineering graduates to serve for a prescribed minimum period in rural areas. Government should also make arrangements to train these candidates after their graduation.
40. Admission to technical colleges should be after Matriculation examination, if necessary, by prescribing some entrance examination. Facilities should be created so that rural population also could benefit from technical education.
41. There is over-crowding in the colleges - selective admission is necessary to weed out the ill-equipped.
42. Poor laboratories, libraries, poorly paid professors are some of the causes for the fall in standards.
43. Audio-visual aids should be used for education and not for entertainment as done today. A regular system of tutorials should be more extensively used.
44. Technicians, scientists and economists of industries and commercial undertakings should be included on the staff on part-time basis. Similarly, staff members should be sent to industry for practical training.
45. Scholarship in a subject field alone is not adequate for a teacher. He should be creative in outlook. More of refresher courses are to be arranged.
46. Institutions capable of designing and manufacturing equipment should be given facilities and encouragement by way of additional staff, space and machinery.

This saves foreign exchange and also helps the development of research wing.

47. There should be no upper age-limit for admission to professional colleges.
48. A condensed course for diploma holders should be introduced in engineering colleges.
49. Thick sandwich type of training should be tried in some selected institutions with the cooperation of the Industry.
50. Out-turn of graduates should be regulated by the actual requirement in different sectors. For instance, even though demand for Civil Engineers is fast going down, their out-turn is no way reduced.
51. Subjects taught should have a bearing on the latest industrial practices, for instance, steam and steam engines have very little application but still are given undue importance in the syllabus. Similarly teaching of surveying and engineering materials in the first year of Mechanical Engineering course has no commensurate returns.
52. In Government offices, Engineers are under-utilised, sometimes even on clerical work. This should be avoided.
53. Existing practice of measuring responsibility as an inseparable part of academic qualification needs change.
54. Wherever the work is of repetitive nature and involves mere execution of a programme or scheme, no graduate engineer should be used; otherwise it is wasteful luxury.
55. In some of the Universities, the rules permit of very limited representation in the Academic Council and Syndicate for engineering institutions. Further, the meetings of the Academic Council are few and far between resulting in inordinate delays in the implementation of many of the decisions.
56. All technological institutions should be given the same status as of I.I.Ts. Any categorisation has a demoralising effect. They should all be given the same facilities, in terms of grants, staff, equipment, etc.
57. Government grants to engineering Colleges should be lump sum block grants. Colleges should have full freedom to decide their requirements of teachers and equipments based on actual needs. Today, most of their time is wasted in satisfying the formalities involved and for the same reason grants are not utilised.
58. Rules regarding Selection Committees are too cumbersome. Colleges should have autonomy to select teachers and to promote them. The present situation leads to large scale migration of teachers. Further, excellent candidates from abroad cannot be utilised because they cannot appear for the "interview".
59. Rigid planning is necessary for producing only those required for the jobs likely to be created or else there will be educated unemployment.

60. A 3 or 5 year pause in expansion of Engineering education should be observed and the period utilised for improving the standards.
61. Curriculum should be problem-oriented.
62. Specialisation should be after graduation.
63. Basis of selections to technological institutions should be uniform as far as possible. Merit should outweigh caste considerations.
64. Academic freedom enjoyed by I.I.Ts. should be extended to other institutions also.
65. Economic engineers, as in Germany, should be trained here also.
66. Three year engineering course after intermediate science is not adequate on account of tremendous explosion of scientific knowledge. It should be minimum of 4 years.
67. Total period of education leading to first degree should not be less than 16 years.
68. Laboratory work needs reorganisation to develop creative thinking in the students. A committee of experts should go into this question.
69. Special programmes for talented students are necessary.
70. Subjects like nuclear physics, research technology and industrial research and development could be covered in the degree courses.
71. It is desirable that technical institutions should be allowed to get affiliated to either engineering universities or to degree-giving Institutes of Technology rather than to the nearest university of general type. This ensures better academic standards.

Post-graduate Studies

1. Today post-graduate education in engineering comprises study for Masters Degree and Doctorate in Engineering. Research facilities are available only in a few institutions. This should be expanded. The establishment of a National Research Fellowship Scheme would provide encouragement for the research.
2. Post-graduate courses should aim at self-education through in-service training extending for periods of three to four years. Attractive scholarships should be paid. It is necessary to provide places for 60 to 70% of the graduates for post-graduate courses.
3. Greater emphasis should be laid on practical training. At post-graduate stage, foreign languages other than English should also be taught. At this stage correspondence courses and audio-visual methods would be very useful, as experts or authorities on particular subjects are not always available in all institutions.
4. A few others, however, feel that at post-graduate stage, too much emphasis on practical training is ill-conceived. Instead the theoretical base should be strengthened.
5. The Ph.D. courses should include course work in addition to thesis work. Every candidate should have at least one year service experience in teaching, research, administration or industry before he is admitted to Ph.D. course.
6. Research should be undertaken not only in colleges and university departments but in professional institutions also.
7. Post-graduate and research work should be given more encouragement.
8. Results of research should be put into practice by compulsion by courts.
9. Even at post-graduate stage, study of subjects of general utility should be continued.
10. At post-graduate level, technical institutions should undertake experimental research as well as design of units of components with a view to producing them in the workshops attached to institutions.
11. Even science graduates should have one to two year diploma courses in specialised subjects of immediate utility as electronics, instrumentation, etc.

12. Universities and Research Institutes must cooperate in the field of teaching. The scientists must get affiliated to the universities and take up teaching work. Such experiment is tried in Germany successfully.
13. Restrictions on the post-graduate training and studies should be relaxed so that there may be a free scope for the institutions to develop the research activities, along with the post-graduate courses as demanded by occasions.
14. Many engineering colleges are having only undergraduate courses with only a few having a plan to start post-graduate in engineering and science subjects. In such colleges no research facilities for the teachers exist. For this purpose the higher institutes of science and technology and technical universities are the ideal places where research work can be done in science subjects in collaboration with Engineering Departments. A definite scheme for providing research facilities for the science teachers of engineering college is necessary.

As a first step, some research seats should be reserved exclusively for the science teachers who will be sponsored by the engineering colleges. These teacher candidates who join research projects at IITs should be assigned some light teaching work during their study in the institute. This teaching/research work ahead would be useful for both trainees and the institute. Of course, they should be suitably financially recouped.

15. Honours standard in Mathematics/Physics should be the minimum qualification for post-graduate studies in engineering. This is necessary because a high standard of physics and mathematics is necessary in these days of rapid technological changes.
16. Heads of Departments should be allowed to have more freedom and time for research work.

At post-graduate and research levels, mutual cooperation and coordination between industries and educational institutions necessary. For conducting research on the problems posed by industries, adequate funds necessary.

17. Sandwich courses could be very useful at this stage.
18. At present research is taken up either to publish some papers or to obtain a doctorate. Main emphasis is more on quantity than quality. Consequently, research workers are tempted to put in faked figures, avoid discussion and consultation with other workers and a fair amount of duplication results.

Research, therefore, has to be planned based on clear objectives.

19. Most research workers today choose the field of specialisation of the Head of the Department (who is himself a specialist) for their research work, in view of limited grants available. As a result, research in other fields suffers. Research planners should see that all specialists get a fair distribution of research workers, money and other facilities.
20. More of discussions and seminars on research work necessary. In practice these are today avoided.
21. Monthly meeting of all members of any department necessary to discuss outline of research work done and offer constructive criticisms.
22. Tendency of Head of Department to get his name associated with all researches in his Department without doing any work himself is not desirable.
23. The natural human tendency of individualism in research limits the scope and usefulness of research work, checks the inflow of ideas from colleagues and thus lowers the quality of research. It creates jealousy towards research work of others. Definitely ruins the research traditions of an institution.
24. In research bureaucratic conditions have to be replaced by cooperative spirit. Inter-departmental and inter-institutional cooperation is essential. Such collaboration between two institutions enables better use of the available equipment and also promotes healthy discussions. Further, it avoids duplication of research work.
25. This cooperative effort should be tried at provincial and inter-provincial levels also, though this may result in curtailment of freedom of research which is unavoidable in the much larger interests of the country. Special considerations could be given to geniuses.
26. The duration of post-graduate courses should be two years as suggested by Thacker Committee.

27. Response to two years post-graduate pattern is not encouraging. There is need for flexibility in the organisation of these courses.
28. There is need for doctorate's degree in engineering permitting specialisation in professional subjects.

Reforms in the Examination System: Suggestions:-

1. At present the academic year extends over nearly 10 months with about 180-200 working days. Despite periodical examinations, tests and other modes of continuous assessment, students resort to intensive studies only in the last one or two months. One remedy to this evil is to split up the academic year into two semesters each of 17 - 18 weeks so that only a few subjects are studied intensively and examined in at the end of each semester. This involves alertness on the part of both students and staff.

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2. There should be continuous assessment at intervals of 3 months to ensure good understanding of the subject and not memorising, on the part of the student. Failure should not entail heavy penalties.
3. Give greater emphasis to practical work.
4. Team work in seminar, symposium or individual effort in writing a technical paper should be given due importance in evaluation.
5. A grading system similar to that of any U.S.A. university should be introduced. The performance of the student throughout his stay in the college, including weekly, monthly, quarterly and annual tests, his assignments, project reports, laboratory work, attendance, attitude to his study - in fact every aspect of his intellectual growth while in college - should be assessed.
6. Allot 50% of total marks for assessing students on the basis of class-work etc. (Sessional marks); similarly 40% of marks should be for final examination and remaining 10% for viva voce test. For assessing a student during a session, the teachers are to be fair and impartial. Even / this system is better than a mere final examination.
7. Students found indifferent on the basis of the periodical tests should not be allowed to appear for the examination. The teacher should have necessary powers in this regard.
8. Moderation should be stopped.
9. The type method of questioning should be changed. Instead of asking mere 4 or 5 questions in one subject, a large number of smaller questions requiring one word answer should be asked.
10. All the examinations should be internal.
11. Fear complex in examinations should be eliminated if examinations are to be successful. If there is just one final examination, education will be exam-oriented. The outcrop of cheap notes and guides is the result of this defective system. There should therefore be a series of tests, which should be corrective in nature and should bear credit in the final assessment.

One of the suggestions is: There should be at least 6 tests bearing 30-40% of total yearly credit, besides mid-session and final examinations. Tests should be one hour duration. Mid-session examination will bear a credit of 20%. Final examination is to bear 40-50% credit. The teachers should be associated with the external examiners in drawing up the question papers and assessing in final examination. All other tests will be by teachers themselves.

12. More viva examinations in laboratory, design and project classes necessary.
13. Minimum pass marks in each subject should be 50%.
14. Levels, methods of examination and mode of estimation should be made uniform throughout the country.
15. Periodical conferences of engineering teachers of universities/colleges necessary to discuss methods of teaching, to compare the results of experiments.
16. Examiners should be carefully selected, properly briefed.
17. Especially for technical students the examination to be on the following lines:-
 - (a) Quiz type of questions to be set.
 - (b) To test general knowledge and points committed to memory.
 - (c) Day-to-day assessment throughout the semester.
 - (d) Reference to books in certain subjects may be allowed.
 - (e) Testing of original thinking power by framing suitable questions.
 - (f) During under-graduate stage facilities for doing productive-cum-training jobs during normal working hours as well as holidays should be provided.

Wastage in Technical Education

1. According to a survey of employment position conducted by D.G., E&T. nearly 50% of the graduates with a minimum of degree feel that their jobs unsuitable. The enormity of wastage of education can be imagined.
2. Every person is to be trained to the best of his or her ability. It would be wastage of manpower if this individual potentiality is not considered for training.
3. Children of the farmers, craftsmen and other working class people are not interested in their hereditary professions but prefer jobs in cities/towns. To obviate this, we should introduce into our system of school education some sort of activity or organisation like that of the 4H Club of America. Children doing well in such an organisation may be taken up to different branches of vocational training.

4. Wastage in Engineering Colleges is estimated to be 35% and that in polytechnics 45%.
5. Besides selecting the students carefully for technical courses, the following steps are necessary to reduce wastage:

(a) effective teaching, (b) admission qualifications for students should include at least two months of industrial training or visits to 6 different industries with number of reports on each industry, (c) increase in the intake so as to offset the wastage. Larger number of scholarships, hostel facilities and better equipment are other steps to reduce this wastage.

Measures suggested for overcoming the shortage of equipment

1. Set up Regional Workshops to give training to a group of institutions. Normally, a laboratory or a workshop in a college with 120 admission and with 30 seats in a laboratory works for only 1/3 of its weekly time. By careful time-tabling, 3 institutions can use the equipment in the workshop. This method will suit only diploma and under-graduate classes.
2. Output of firms manufacturing scientific equipment should be increased.
3. Encourage well-established industries to manufacture as much of our special equipment as possible.
4. Release as much foreign exchange as possible for equipping the technical institutions.
5. Steps should be taken to ensure that the quality of equipment already being manufactured in the country is improved.
6. Set up a factory of the type of H.M.T. in collaboration with an established foreign firm.
7. As done by Japan, we should try to manufacture our own equipment. Import just one machine and start manufacturing in India similar units.

8. Instead of establishing new technical institutions, expand the existing ones, if necessary, by working in double-shift.
9. Full-fledged institutions should be allowed to undertake the design and manufacture of some prototypes. As an alternative, an imported equipment may be supplied to these institutions to be stripped so that new ones could be manufactured.
10. By and large, major portion of the equipment required for technical institutions for under-graduate work is being manufactured. Only more sophisticated machines with great accuracy, experimental set-up and equipment for research students are not available.

Import of equipment can be substantially reduced by constituting a design and manufacturing cell for simpler types of experimental set up. This unit may be built around well-established institutions with a large workshop. Each such institution could specialise in certain types of equipment only.
11. Sophisticated equipment for polytechnics is not necessary. Indigenous material should do.
12. By shift working better use of the existing equipment is possible.
13. Ministry of Education should undertake the procurement of foreign equipment and distribution of the same among the institutions. This saves considerable manhours.

Medium of Instruction

1. This question in technical institutions is a very complicated issue and we should not be led away by sentiments or emotion. Experience of other countries in this regard would be helpful.

In Japan, bands of young and brilliant persons were sent out to study modern sciences. On their return, they undertook the great task of translation of science books. Study of foreign languages was introduced in high school and college syllabi. For mass education the Japanese ideographic script of 80,000 characters was simplified and reduced to 73 letters, thus giving a good momentum to mass education.

In USSR, which is a multi-lingual country with a wide range of languages and dialects (about 200), out of which about 16 are the main languages having literary traditions - the policy of the Government since 1917 has been to promote the development of Regional languages. Numerous books on scientific subjects from various modern languages were translated into these languages and gradually these were introduced as media of instruction even for university education. Many of the dialects having no literary traditions were given new scripts by modifying Russian script and mass-education programmes launched.

China: In the post liberation era 23000 characters of their ideographic script were reduced to 515 simplified characters. Numerous books on scientific subjects were translated to

Chinese. The medium of instruction is Chinese even at university level. Russian is taught as a second language.

Thus, "Medium of Instruction" and "Learning of Foreign Language" are two separate issues. Both English and regional languages are necessary for their own purposes. Mother tongue is the best medium of instruction. All our languages have rich literary traditions and can be easily developed. In Russia, even languages like Uzbeki and Kazdkh have been developed.

Central Government should form a full-time "Language Project Department" consisting of sub-divisions one for each of modern technologies with clear directions to complete in a given period (say 5 years); the work of forming "Common terminology" and preparation of suitable text-books wherever appropriate English terms can be accepted and retained. This work should not be left to the voluntary efforts of the people. Immediately after this, regional languages should be adopted as media of instruction.

2. There is no gain-saying that the translation of technical and scientific terms in our country will take a long time to be completed and accepted and adopted. As such, any change in the medium should be gradual.
3. At present our country produces only a negligible number of books on technical subjects. Consequently we are forced to use books originating abroad. These books though well-written sometimes cause confusion in the minds of the beginners. It is, therefore, imperative that we produce our own books.

The reasons for our not producing any books are: (a) There is hardly any real research work on engineering, (b) Engineering teachers who are the most

competent persons to write these books are overburdened with routine work.

4. Library is an essential and integral part of any educational institution. A liberal policy towards purchase and distribution of books has to be followed.
5. Facilities and additional increments may be granted to teachers to write text-books.
6. It is agreed on all hands that in the craftsmen training programmes and in the Secondary high schools, the medium should be the regional language.
7. Opinions differ about the medium of instruction in Diploma and Degree courses. Many authorities feel that the medium at this level should be English and that adoption of any other language will present difficulties.
8. A few, however, feel that medium of instruction at all levels should be the regional language with necessary English technical terms. At the other extremity is the view held by a few others that English should be the medium at all levels in technical education.
9. Students entering college have such poor knowledge of English that they cannot follow the lectures for the first two years, especially in the study of medicine there is no substitute for English. The subjects covered during the first two years of the course are of such fundamental importance, that this results in a serious situation. Teaching of English at the school level should, therefore, be strengthened.
10. In professional courses medium should be English.
11. For diploma courses and degree courses the problem of medium is rather complex. English should not be completely removed from our syllabi. However, it need not be made compulsory. This change should not be enforced hurriedly without any preparation and planning. As the technical personnel have to work anywhere in the country, it is very convenient if a common technical terminology is adopted by all regional languages.

At the university level of engineering, introduction of mother-tongue means shutting out the door to knowledge. At this stage, the issues of (a) medium of instruction; and (b) learning of English should be separately considered. As comprehension is far more through mother-tongue, this should be the medium of instruction. If this language handicap is removed, talents of many students from villages who are bright but poor in

English could be fully utilised.

12. Another view held is that if English is to be ultimately replaced, it could as well be done now at least in the new institutions and thus lakhs of rupees could be saved. Mother-tongue brings technicians as a class very close to the common folk who are thereby sure to be enthused with our developmental works. However, English should be taught as a language up to the last but one year. Teaching of English language will enable a student to read technical books and magazines in English and add to their knowledge.

After proper preparation of textbooks etc., in regional languages with common terminology, English should be discontinued. For this work a definite time-limit say about 5 years must be fixed.

Such adoption of regional languages as medium of instruction will not adversely affect national integration. Rather it would promote the cause of better education.

Even introduction of Hindi as the medium of instruction cannot serve the purpose as well as the mother-tongue. However, for the sake of national integration Hindi should be compulsorily taught as a language from 5th to 11th standard.

13. Medium of instruction in all business courses should be English/happens to be the language of business. This problem should be examined independently of the language issue facing the country today. If our businessmen lack adequate power of expression it is because the English taught is not of the adequate standard.
14. According to some suggestions received, the following should be the medium at different levels.

(a) For skilled workers) English and/or
or for certificate) regional language
courses lasting) mixed should be
over less than 2) the medium.
years.)

(b) For polytechnics)
and Engineering) English
Colleges.)

Meanwhile, develop regional languages, fully incorporating all English technical terms without attempting any translation of those terms.

Part-time/correspondence courses

1. Most of the educationists feel that part-time and non-courses are very useful not only for augmenting the stock of technical manpower but to afford necessary facilities to improve their professional competence for all those who for various reasons, financial or otherwise, had to discontinue their studies and join industry.

Following are a few of the important views received in this regard:-

2. Part-time courses in technical education are not good as the standards possible of attainment through such courses will be far from satisfactory; correspondence courses are even worse in this regard.
3. Another school of thought is that the products of Part-time Courses will have far better practical knowledge and thus will prove to be more capable engineers. They feel that part-time and sandwich courses should therefore be encouraged. Correspondence courses will, according to them, produce half-baked people.
4. Part-time courses are good only for lower levels while correspondence courses will be all right at higher levels i. e. for post-graduate studies.
5. Part-time classes with day release would be preferable to evening classes.
6. Besides formal continuous education, provision should be made for school-leavers at various stages to better their prospects by improving their professional competence. Thus, a J. T. S. student, while working, should be able to get a Diploma. Similarly, a Diploma-holder should have scope to get a degree, when he is in service. Part-time courses meet this requirement admirably well. They should be conducted as far as possible in all institutions by providing necessary facilities, so that the students need not have to go far for their classes.
7. As these courses are for those engaged in industry, their structure should be more and more industry-oriented.
8. Industry should be persuaded to release its employees for these part-time courses.
9. Part-time courses can be successful only in big cities with a number of industries. It is no use starting them at all places, irrespective of lack of industries around.

10. If correspondence courses are introduced to meet the acute shortage of technical personnel, they should be supplemented by a course of institutional training for tutorials and laboratory classes. The students should be encouraged to take correspondence courses only in the subjects they are normally connected with in their employment.
11. Part-time/Correspondence Courses are to be very carefully organised and strictly supervised. It should be ensured that mushroom institutions do not grow.

According to some, for the present, when there is acute shortage of equipment for training in practicals, correspondence courses should not be started.

12. Provision of earning opportunities while studying in the college may not benefit many. But part-time courses for those in service would be beneficial.
13. Part-time courses should be designed to meet the needs of particular industries and should be conducted by the industries themselves with the assistance of nearest polytechnic/Engineering college. Such part-time courses should preferably be geared to the examinations conducted by professional bodies like Institution of Engineers (India) etc. Correspondence Courses should be strictly confined to ministerial and accounts staff who can with advantage pursue such courses and qualify in examinations conducted by professional bodies. Correspondence courses for engineering studies are not good.
14. For persons already working in industrial establishments, evening classes are convenient to impart the necessary theoretical knowledge to enable them to advance in their profession. The present duration for the part-time evening classes of engineering, diploma courses of polytechnic institutions in West Bengal is five years. It can conveniently be reduced to four years.
15. Examinations of different courses should be so timed as to enable the student of one course, if he fulfils the admission requirements to join the other. This is not always done. For instance, while admissions to condensed degree course in Jadavpur University are made in April, the final examination of part-time diploma courses in engineering is held in the month of May and results announced still later.

16. Diploma holders and craftsmen should be given full opportunities to improve their qualifications as follows:-

- (a) Part-time diploma courses may be offered for craftsmen.
- (b) External degree course may be provided for diploma holders. Necessary laboratory experience should be provided for.

This external degree course is essential as the part-time degree course for diploma holders cannot always be fully used as the diploma holders are naturally stationed in far off places.

17. Industrial workers in private sector should be provided opportunities to acquire theoretical knowledge and improve their prospects in service by attending evening classes. Two or more small factories may combine and arrange for the same.
18. Day-release workers in private sector may study theoretical subjects in technical schools like the Calcutta Technical School.
19. "Practice courses" are gaining popularity in U.S.A. in place of cooperative engineering education. Under this new pattern, groups of post-graduate students are assigned to different industries to study specific problems and offer solution. These assignments are a regular part of the post-graduate courses. An adaptation of this pattern in our country may be considered.
20. 'Course writing' for correspondence courses should be got done carefully. In view of the enormous preparatory work involved, it will be better to start part-time course on a big scale and gradually switch over to correspondence courses.

Cooperation with Industry

1. The private business and industry should realise that the technical and professional personnel are being trained for ultimate absorption in their business or industry. It is, therefore, in their interest that technical personnel should be adequately trained on the job to suit the particular requirement of the business and industry.
2. Industrial firms and organisations should start training courses for their own requirements. Shortage of trained and skilled workers could thus be overcome.
3. Every industry must conduct at least one training school for its workers. Such training may (a) an integral part of education given in vocational schools, polytechnics and colleges (b) extension training after the completion of college education and (c) pre-employment training.

An example of (a) above is the regular ferrous metallurgy course conducted by the I. I. T., Madras in collaboration with Tata and Hind Steel for a period of 1½ months.

4. Certain group of industries may come together for running a diploma institution of their own.

In all cases, the training should be effective, well-organised and supervised.

5. No educational or training institution can train a man fully for a particular industry unless the institution is attached to that industry itself. The educational institution should, therefore, concentrate on scientific or technological education and basic training, leaving to the private industry the task of providing the final training so as to make the students ultimately suitable to a business.
6. Cooperation of industrial and commercial concerns should be enlisted in training the students in latest techniques. The firms should individually or collectively place one training centre of each type of jobs at the disposal of participating schools.
7. Suitable legislation should be passed so that engineering students get proper training in industrial organisations. All such practical training should be properly planned and guided.

- Vocational, technical and professional education should be a charge on industry. In industrially advanced countries, the industry itself supports such education financially and also in the form of equipment. This should be done here also.
9. All big industries should be taxed in proportion to their requirements of technical personnel. The profits should be devoted for educational advancement.
 10. Industry should set up research and design units in their respective fields. Thereby, facilities for training and research would greatly go up.
 11. All industries must be made to introduce well-organised and supervised apprenticeship system. If necessary, they may indicate their requirements and standards in this regard. This apprenticeship must be linked with university education system as far as possible, to enable the students to take up the degree. This would reduce rush to engineering colleges.
 12. Industry should admit every year a limited number of qualified technical students and give them intensive training. There should be an element of compulsion in this regard. Licences may be cancelled if a prescribed number of persons are not trained every year.
 13. Private industry should select suitable students before they complete their studies for employment and training in their respective organisations.
 14. Industries should sponsor its selected persons who are capable of assuming key positions in their organisations, for training in institutions.
 15. Private business should be discouraged and finally nationalised to ensure that adequate training facilities are provided. State should have full control over industries.
 16. Institutions should be located in factories or plant areas.
 17. Industry should give all facilities to technical students to see its working, at least once a week.
 18. Industry should be compelled to set apart a certain percentage of its income to keep the cause of technical education. It should also help in the setting up of specialised laboratories and by way of fellowships and scholarships.
 19. Private industry should be encouraged to depute its staff including senior executives to work in educational institutions as teachers on a part-time

basis or in the evening or at night. This would be an advance investment by industry yielding rich dividends.

20. Cost of research should be a charge on industry. Industry should be encouraged to refer its problems to technical institutions. In fact, the technical institutions should approach the industry for this purpose. The solution should be quickly made available to private enterprise.
21. Technical institutions should associate private enterprise with training programmes so that common defects in the scheme could come to light.
22. Industry should provide, within the first 10 years of the employees' service, opportunities to improve his qualification by joining evening classes.
23. Qualified factory workers should be given preference for teaching in technical institutions.
24. Student trainees should be paid the same salary as regular employees, while undergoing training. They should be entrusted with the same responsibility also.

(According to a few others, these student-trainees should be paid as semi-skilled workers or attractive stipends).
25. Private industry should give part-time employment to students studying technical courses, during their vacations.
26. Private industries can finance technical education by giving scholarships to students following the type of technical training needed in these industries. Later on, they may be absorbed in their organisations.
27. Industries should be attached to particular Technical Institutes, on a regional basis.
28. Management should give special short leave (for about 2 days in a week) to its employees to help them in their part-time studies.

Technical Teachers & Teaching Techniques

1. Shortage of teachers in departments of engineering can be overcome by offering more attractive terms and social status to teachers so that brilliant young graduates are attracted and retained in teaching profession. For want of this attraction only third rate engineers frustrated in other fields take to teaching.
2. To prevent constant migration of teachers from institution to institution, the pay scales in all the institutions should by legislation, be made uniformly the same.
3. Following incentives for attracting graduates as teachers are necessary:
 - a) Lucrative pay scales
 - b) Suitable staff quarters
 - c) Recognition of merit
 - d) Facility for research; publishing papers, text-books.
4. There is today a flight of teachers from institution to industry. In fact, this flight should be in the opposite direction i.e. from industry to institutions. Suitable conditions should be created for experienced engineers in the field to join the teaching profession.

Competent technical personnel from industry should be employed as teachers on part-time basis.

Engineer-teachers who are engaged both in industry and institution should thus be developed.
5. Teachers should work in well-established factories for two months every 3-5 years to acquire up-to-date practical knowledge.
6. Participation of experienced engineers in the teaching work of institutions should not harm their prospects in their present organisations.
7. Teachers should have opportunities for training on an assisted programme basis.
8. 2-year Diploma courses and 3-year Degree courses can reduce the shortage of teachers.
9. Recognise and reward meritorious work.
10. To increase the supply of teachers, simplify recruitment procedure. The present recruitment procedure of conveniently excluding the professional people from competing or even applying should be discontinued. Again, the insistence on sending the applications through "proper channel" excludes quite many. This should be abandoned.
11. Students of final year with good expression should be given some teaching experience of junior classes. Select such young, bright boys in colleges and polytechnics and offer good scholarships on the condition that they serve as teachers. Train them in industry and pay good salaries on appointment as teachers.
12. Students of post-graduate classes should be allowed to handle classes.

13. Technical personnel qualifying from abroad should be made to serve the country for at least a stipulated minimum period.
14. Services of all those engaged in non-educational pursuits should be utilised to augment the supply of teachers.
15. Use services of retired engineers, professors and technicians as teachers.
16. A.M.I.E.s also should be considered eligible to become university teachers.
17. Staff in technical college should be on contract basis.
18. All enthusiastic engineers should be allowed to become teachers. The present insistence that polytechnic teachers should necessarily have secured first Division in the colleges is unrealistic and should be discontinued.
19. During vacations, teachers should have facility to receive practical training or attend summer school.
20. Honours and post-graduate teachers must have enough practical experience.
21. Teachers' Training courses should be introduced at many more institutions. These training programmes should contain the following elements:
 - (a) Development of skills in two or more subjects.
 - (b) Training in psychology and modern techniques of teaching.
 - (c) Sound general education.
 - (d) Command of Language.
22. Many States are unable to benefit from Teacher Training programmes of the Government of India as they cannot offer the higher rates of pay specified. This further underlines the need for the implementation of AICTE scales of pay.
23. Besides Regional Colleges of Education which are training craft teachers, State Institutes of Industrial Education should be started in every State.
24. I.I.Ts should train technical teachers.

25. New recruits in teaching should work jointly with Senior staff for at least two years before being given independent charge.
26. Short-term teacher training programmes should be conducted.
27. Shortage of qualified teachers is because of improper planning, resulting in surplus of students receiving technical education for no productive purpose.
28. The calibre of teachers should be considerably improved by deputing them abroad for short periods for further training.
29. Indian Engineering Service should be started immediately; similarly, on all-India Cadre of Technical Teachers should also be instituted.
30. Teachers should be allowed private consultancy.
31. Many AMIE teachers naturally like to take up higher studies but are not allowed to do so as university does not recognise AMIE as equivalent to B.E. This anomaly should be removed. Teachers in Engineering institutions who have put in 5 years of teaching and who have passed sections A & B of AMIE should be considered equivalent to B.E. and allowed to study for post-graduate courses.
32. As conducting such exams by one body would be unwieldy, universities should agree to external degree courses for diploma holders.
33. Summer courses should be ^{so} patterned that 4 or 5 courses lead to a university degree.
34. After 5-7 years of service, CTI teachers should be given a refresher course.
35. Teachers should have less routine administrative work.

Their teaching load also should be reasonably light to allow them enough leisure to take up self-study. They should be encouraged to take up post-graduate courses and should be offered facilities for research.

36. Teachers should freely be given sabbatical leave for studies, writing books etc.

37. Research degree need not be always necessary for promotion of science teachers as Readers and Professors. The experience gained should be given due weightage.
38. Liberal use of models of bridges, dams, and other audio-visual aids should be resorted to in teaching technical subjects.
39. The final 2 years in Engineering courses should be handled by experienced professors only. The practice of visiting professors should be encouraged. Lecturers should handle only basic engineering subjects.
40. A good technical library should be attached to each college/university.
41. For selection of experienced persons as teachers, age limit should be waived.
42. Amenities like free quarters, clubs etc. should be liberally provided to teachers.
43. Engineering colleges should be permitted to recruit some staff in excess of a number justified by the teaching load so that these persons could attend the classes of some chosen professors in the college and help them as under-study. Subsequently they can take over teaching work and fill up vacancies.

Administration of Technical Education

1. While a small number of educationists feel that the present administrative set-up is all right, majority feel that some reforms are urgently called for, if Technical Education is to be effective.
2. Technical and Vocational education is at present scattered over a number of departments/ministries, resulting in ineffective coordination. All such training programmes should be brought under the same administrative control/Ministry for instance, Junior Technical Schools and I.T.Is. should be run by the same Ministry for ensuring uniform standard and better coordination. Similarly the Institutes run separately by the Ministries of Railways and Defence should also be merged.
3. Diploma courses are under the control of respective State Governments. However, there is total lack of coordination in this area, as the very names of the State Councils of the different States indicate. In West Bengal it is the State Council of Engineering Education, while Bihar has a Board of Technical Education. In some States, the Council is under Education Department, while in others it is under Department of Industries. In some States, there is dual control also. These anomalies lead to considerable delays in the developmental activities and should be removed.

4. Engineering colleges should be placed under the Director of Technical Education. The posts in the colleges should be made inter-changeable with the corresponding posts in the administrative wings.
5. To raise the quality of education, it is necessary for the Government to have full control over the colleges. Only then can selection of really talented students be possible. The other alternative is to raise the admission requirements.
6. Allow Institutions to have their own special subjects and courses besides the normal conventional ones. Similar decentralisation in evaluation and other academic subjects is necessary. Common features should be reduced to the minimum so that institutions can grow by healthy competition.
7. Separate Technical universities should be created.
8. Higher posts in Technical Education should be with technically qualified men. Heads of Govt. Engineering Colleges and Polytechnics should be members of the All-India Service.
9. Recruitment procedure should ensure that only capable, duly qualified and experienced persons are selected as principals/teachers.
10. Trained instructors, supervisors and foremen should be posted to guide and improve training.
11. Government machinery is very slow mainly because Govt. has no control over the different Govt. servants, in view of constitutional safeguards. Principals should be given greater powers to enforce discipline.
12. Regional colleges, are, in practice, not really autonomous but are run like any Government departments.

As a result of the excessive Government interference, the standards especially in Government colleges are going down. To remedy this, education departments should be staffed by educationists. Similarly, in the Board of Governors, there should be an overwhelming majority of educationists. Industry also should be adequately represented.
13. State Board of Technical Education should be entrusted to run the Technical institutions and not merely to conduct examinations. It should, in fact, be a statutory body and not a mere Advisory body.

14. Private Colleges which do not come up to certain standards should not be recognised or affiliated to universities or they should be taken over by Government. The staff should be trained in the maintenance of the equipment.
15. Create an inspection wing of the Directorate of Technical Education, to inspect each Department of Engineering in a college. This work cannot be done by the Principal in addition to his other duties.
16. Create post of Registrar or administrative officer and relieve the principal of routine administrative duties.
17. There is too much regimentation in the areas of equipment, space and administration; enough latitude is necessary.
18. Only qualified staff should be appointed in colleges. Professors should be doctorates or of 10 years standing with Master's degree qualifications. The Readers/Assistant Professors should have minimum qualifications of Master's degree with five years' experience. Lecturers/Assistant Lecturers should have first class degree or high second class. There should be provision for the colleges to send their teachers for higher training under the Teacher Training Programme.
19. Instances are not wanting when most obsolete equipment has not been replaced because of procedural delays, or unrealistic grant-in-aid code, thus throwing the institution far behind times. Each institution should have a block grant with freedom to decide their requirements of teachers and equipment. This is to be reviewed in 2 or 3 years.
20. Some educationists feel that teaching faculty also should be involved in administration, while others feel that teachers should not be burdened with routine administration, correspondence, etc.
21. Rules and restrictions regarding drawal of grants sanctioned already involve great delays. They are to be made realistic.
22. More and more of loan scholarships should be awarded to help needy students.
23. Norms for the colleges should be fixed.
24. All engineering colleges must receive full financial aid direct from Union Government or U.G.C. State Governments are unable to meet their demands.

25. Rules regarding Selection Committees for appointing the staff members are not conducive to efficiency. Colleges should have autonomy to select teachers and promote them.
26. Candidates from abroad need not appear for interview before selection.
27. National Trade Certificates should be introduced instead of departmental trade certificates, and the same should be recognised by all. At present the employers take their own test in spite of institute certificate. A plumber, a wireman will have to obtain licence notwithstanding National Trade Certificates.
28. Engineering/technical education should be a concurrent subject. The present organizations like AICTE (with 4 regional committees and 7 Boards of Technical Studies), NCERT, DGE&T and Indian Society for Engineering Education could be profitably integrated.
29. An Indian Engineering Council on the basis of Indian Medical Council should be set up.
30. AICTE, UGC, Ministry of Education (Technical Wing) concerned with technical education should be combined into one body. Officers of this body should have received engineering education themselves.

31. Till secondary examinations throughout the country are of the same standard, it is desirable to have a common entrance examination at regional level for technical institutions.

Suggestions for the improvement of Technical Education in general

a) Shortcomings noticed in institutions needing urgent remedial action.

1. In many institutions, workshops, laboratories are not fully equipped.

2. There is an alarming lack of qualified teachers on a continued basis.

3. Standard of students admitted to Engineering Colleges is not high. For this, school education should be improved and made stimulating.

4. Staff-student ratio is too high, preventing individual attention being paid to students.

5. Want of enthusiasm on the part of students to learn is a great hurdle. Today, they are just keen to pass their examination.

6. Lack of adequate libraries and study rooms for the teacher and the taught is a handicap.

7. Want of museum for housing the old/obsolete equipment hinders a proper appreciation of the evolution of the present-day machine.

8. Adequate audio-visual and other teaching aids are a keen necessity.

(P.T.O.)

9. Facilities for the education of children of teachers are lacking. These are very necessary, especially when colleges are situated far away from cities and towns.
10. Text-books are not readily available. Cheap editions of foreign publications should be arranged on an extensive scale.
11. Regular supply of raw materials is not ensured.
12. Curriculum does not lay adequate stress on workshop and field training and on experiments. Mere text book knowledge appears to be the aim.
13. Other shortcomings are: Approach Roads, play-fields, staff quarters, compound walls and adequate water and electric-supply, common assembly hall.
14. Affiliated colleges have no freedom to devise/adopt an experiment in any modernising course or examination system. Reasonable freedom in this regard is necessary.
15. Facilities for learning foreign languages (like German, French and Russian) should be provided in Engineering colleges.
16. Many institutions labour under the disadvantage of inadequate funds.
17. Difficulties in the colleges are aggravated by inadequate preparation of students in science and mathematics at school stage.
18. Hostel facilities do not always exist. Provision of hostel facilities is desirable. Especially for institutions located in rural areas, it is a must.
19. The ideal will be to have every student in the hostel. This would facilitate working in two shifts. As this is not practicable always, at least all needy and those coming from outside are to be provided hostel accommodation.
20. At the level of ITIs, today, only lodging facilities are provided to students: This is not adequate; Boarding facilities are also necessary.
21. In Engineering Colleges, hostels should be provided for only 25% of the students as these institutions are normally in big cities and students are from upper class families. This percentage should be 50 in polytechnics and 75 in J.T.S. and I.T.Is. While separate rooms are necessary for post-graduate students, four-seated rooms are adequate for post-matric students.

22. Hostels should have other facilities like a gymnasium, swimming pool, recreation centre, reading room, library, etc.

b) Other Suggestions for Improvement of Technical Education

1. Teaching of Science and Mathematics at the school stage is to be considerably strengthened if students are to benefit from technical education. Studies in our schools are more theoretical. This is to be corrected by providing workshop training for three periods a week and also some training in skills as model making, etc.
2. A practical bias to the teaching of science and social studies in schools will help the growth of scientific and technological talents for further studies.
3. As many students cannot afford to purchase text-books more and more of book banks/textbook lending libraries should be opened. The book bank movement should be put on a statutory footing by adding voluntary organisations.
4. Efforts being made in the Ministry of Education to bring out cheap Indian editions of costly foreign textbooks should be intensified.
5. As many precision instruments are to be imported, special consideration may be given to technical education in the release of foreign exchange.
6. Architecturally beautiful buildings are not always necessary for engineering institutions.
7. More grants and scholarships necessary to support research into teaching methods for engineering subjects. Also large number of loan scholarships should be instituted - on the pattern of L.I.C. but reverse in operation.
8. Universities and Research science institutes must cooperate in the field of teaching. The scientists must get affiliated to the universities and take up teaching work. Such experiment is tried in Germany successfully.
9. At the university level, foreign qualified staff should be included and the existing staff should be trained abroad.

10. Reorganisation of higher education is necessary with greater emphasis on scientific and technical faculties (including agriculture) and relatively less on humanities, fine arts and law. Improvement of students is more important than mere quantitative expansion.
11. Students in secondary and pre-professional classes should be addressed periodically by teachers of professional institutions and others in relevant professions.
12. Initiative of talented youth is not recognised and adequately nurtured in the colleges mainly because of inappropriate handling by inexperienced teachers.
13. In classes, make extensive use of technical documentary films of the type prepared by British firms (Dunlop, I.C.I., British Information Service, etc.
14. Elements of agricultural and standardised skills, manual and mechanical as well as orientation for technical life should be imparted in general science. Manufacture of indigenous machines for all schools should be taken up.
15. Now that the retirement age has been raised from 58 to 60, age of admission to service should also be raised. Minimum age for admission to technical schools should be 18 years. This is based on biological and developmental grounds.
16. The future librarians will have to be experts on technology. Suitable training is necessary.
17. Create suitable employment opportunities and also necessary atmosphere that agriculture is also a good industry. At the end of the course suitable degrees or diplomas should be awarded as the parents like to have.
18. "Journalism" is receiving scant attention in our educational system. The position should vastly improve.
19. Management education should also be expanded. It should be university-based and Commerce Departments having affinity with Business-management should be given this responsibility.

Teaching material relating to business-management should be prepared by taking as base the existing managerial practices in India and not by more wholesale adoption of American methods and materials.

20. Commerce education should be liberal at degree level and specialised at post-graduate stage. At degree level, in addition to the study of commerce subjects, study of languages and Mathematics should be compulsory.

Progress of commerce and management of education in our country has not proceeded on right lines. It is a fact that quantitative inadequacy exists simultaneously with superfluity of commerce-educated persons. In spite of increasing need for commerce-educated personnel, educated unemployment is also on the increase. Government has classified commerce education as technical education and has set up an all-India Board of Technical Studies in Commerce. The powers of this Board include framing of standard courses of B.Com. and M.Com classes and also of examining development schemes of Commerce Departments of Engineering. This is an irrational approach as it cuts out the autonomy of universities and also it is wrong to treat Commerce as a professional or technical discipline.

21. In the Commerce profession, courses should be carefully designed, so that girls also might take up such subjects and prove successful sales-girls, Stenos, Steno-typists, telephone operators, etc.

22. Detailed Demand Schedules of Manpower - districtwise, region-wise - should be prepared, to cover all spheres of industry, commerce, trade etc. for a realistic and successful planning of manpower needs.

A thorough study of employment areas and opportunities should be made immediately especially in States with high rates of un-employment.

23. Products of engineering institutions lack initiative and exhibit little patience with liability to get frustrated within a short time. Admission of ill-equipped students who expect quick return is the cause for this defect. They have no liking or aptitude for technical knowledge. Adequate guidance should be provided in selecting the branch of engineering for study.
24. Selection should be based on aptitude tests. In all institutions a minimum standard of achievement should be insisted upon.
25. The present imbalance of a glut of graduates without the requisite number of diploma holders has been responsible for many short-falls of production and of construction etc.
26. Until our industrial development is sufficiently advanced, it is harmful to create unemployment among technically-qualified personnel, by expanding technical education indiscriminately. Requirements of technical personnel should be carefully drawn up to plan expansion of Technical Education.

27. To broaden the cultural outlook of the pre-professional students, the teaching of sociology should be transformed so as to impart some knowledge of cultural history, history of world literature and some of the most important events in the History of area.
28. Admissions to higher courses particularly in the professional field should be on pure merit as judged by a Board. System of cumulative record of class marks should be dispensed with, as it has led to gross abuse and deliberate manipulation. Admission by donation should be condemned.
29. The present system of interviews of students for admission to professional courses is unsatisfactory. The aptitude of the candidates cannot be judged in a brief interview lasting only a few minutes. A written test instead of such interview would be more purposeful. Admission to technical courses should be made after two year pre-degree course.
30. To ensure a uniformly high standard, it is absolutely necessary that the admission requirements are in no way relaxed.
31. Provide adequate space, equipment, and qualified teachers. Students should be carefully selected, enforcing a national standard at the Higher Secondary level to serve as a criterion for admission to technical institutions.

32. A central Technical Educational and Training Council should be set up to bring about necessary reform in technical education and training- especially an appropriate blending of theory and practice. The Council should consist of representatives of (a) employers, (b) educationists, (c) trade unions, (d) others with special interest in technical Education and (e) State level Boards.
33. A forum for discussion on topical technical matters should be provided.
34. Students seek admission only to courses in Engineering and Medicine and not in other professional courses. This is because of the limited job opportunities for other professions. The solution to this situation lies in increased industrialisation.
35. There should be uniform system of technical education all over the country to facilitate, among other things, migration of students. For this purpose in each college a certain percentage of seats should be reserved for students of other States.
36. A number of autonomous institutions with colleges of science, Arts and Engineering etc. should be set up. Such integrated institutions help cross-fertilisation of idea and help in a balanced, wholesome and complete university education in many disciplines.
37. Establish an institute of the type of city and Guide London Institute to provide a machinery whereby the minimum requirements in any particular activity are identified and facilities provided to young employees to improve their knowledge through self-study.
38. Faculty development is possible by adequate recognition and encouragement of merit; freedom for experimentation and provision of necessary facilities for research and participation in curricula development.