

Needs analysis of automotive workshop equipment based on Indonesian national standards

Andoko & Willy A. Wirawan

State University of Malang
Malang, Indonesia

ABSTRACT: The aim of the research described in this article was to identify the adequacy level of automotive workshop equipment in vocational high schools in Malang City. A quantitative descriptive survey research design was adopted for the study. Data were collected using checklists, unstructured interviews and documentation, and then analysed with descriptive statistics. The research population were vocational high schools in Malang City that have good automotive laboratory/workshops according to the Education Board of Malang City. Three public vocational high schools were selected as samples. Results showed that a) the adequacy level of automotive workshop equipment in vocational high schools in Malang City belongs to the *well-equipped* category (69%); and b) the work areas for workshops in vocational high schools in Malang City were sufficient (47%). The assessment was based on the National Agency for Educational Standards in the Regulation of the Minister of National Education No. 40, 2008.

INTRODUCTION

Secondary vocational education plays a pivotal role in equipping students with competences necessary for either being self-employed or working for an employer. Therefore, the development of secondary vocational education is orientated towards fulfilling labour market demand. A vocational high school (*Sekolah Menengah Kejuruan* or SMK) is an institution that is required to produce well-rounded and work-ready graduates for the future workforce [1].

In selecting subject matter - or content knowledge - vocational schools have to keep abreast of developments in science and technology, as well as the needs of society and business and industry trends [2].

Sonhadji [3], as cited by Slamet [4], opines there are three principal characteristics of engineering education:

1. emphasis on psychomotor learning;
2. adaptation to technological advancement;
3. orientation toward the field of work.

Engineering education places a heavy emphasis on psychomotor learning and motor skills. Providing adequate facilities and infrastructure is one way to support the improvement of student technical and practical skills. More specifically, the development of practical skills is supported by managing the upgrading of facilities and the infrastructure of school buildings, workshops and laboratories.

A school instructional workshop or laboratory reflects a part of industry in a school setting with facilities similar to those in factories in industry [2]. A good laboratory can accommodate hands-on activities or research due to the provision of complete laboratory equipment and infrastructure. All activities in the laboratory should be systematically organised to function optimally.

Studies have revealed several aspects of laboratory management [3][4]:

1. proper arrangement of laboratory facilities in terms of room layout, equipment maintenance and safety rules;
2. fairly poor organisation of laboratory facilities regarding the working environment, maintenance, repair and replacement of equipment;
3. better management of laboratory facilities at private versus public universities;
4. mechanical engineering laboratories have the same quality of facility management.

The results of this study also confirm previous research in which laboratories were found to be in poor condition, did not meet the minimum standards and the procurement of tools and materials was deficient.

The National Accreditation Agency for Higher Education (*Badan Akreditasi Nasional Perguruan Tinggi* or BAN-PT) found that many vocational schools in Malang do not have fully equipped laboratories, so as to meet student needs [5]. There is concern that these schools will cease to be effective in vocational teaching (*Radar Malang*, May 2009). The inadequacy of laboratory facilities is also a major problem for some automotive mechanical engineering vocational high schools in Malang.

There is much educational inequality in Indonesia, including at vocational high schools. Not all vocational high schools can provide workshops that are well equipped, modern, and with strong links to the real world of work. Vocational high school teachers often cannot keep up with technological change and the latest pedagogical methods. In fact, many vocational schools remain rather unchanging, and consequently the institutions produce graduates who lack competence [6].

Studies confirm that workshop equipment in a number of vocational high schools is insufficient [4]. In addition to the limited amount of equipment, the available apparatus is outdated and thus unsuited for today's industry.

Despite government efforts to increase the number of vocational high schools, the low quality of vocational education is still an issue. Vocational high schools, which are supposed to produce skilled workers, often fail to train their students properly due to a lack of state-of-the-art workshop equipment. Approximately 55 percent of equipment in the vocational high schools is below the national facility standards [7]. Compelled by the issues addressed above, this study investigated the existing workshop equipment and facilities in vocational high schools and their needs based on the requirements of the National Agency for Educational Standards (*Badan Standar Nasional Pendidikan* or BSNP).

RESEARCH METHOD

To conduct this research, a quantitative approach with a descriptive survey was adopted. The descriptive survey is a method of research intended to describe information about symptoms, events and actual conditions of the research object. A survey was used to obtain data through several techniques, including questionnaires, administering tests and conducting structured interviews [8].

The survey design was selected to outline the prevailing view of an issue without manipulating the variables under study. Therefore, this research is a descriptive study. The purpose of this study was to determine the existing conditions and availability of automotive workshop equipment in vocational high schools. The study is warranted, because automotive workshop equipment plays a key role in the outcome of vehicle maintenance and repair. The research subjects were vocational high school teachers, students and alumni who have used the school's automotive workshop.

The research *population* consisted of all automotive laboratory/workshop equipment in public vocational high schools in Malang City. The study sample consisted of three public vocational high schools, which have a study programme in automotive mechanical engineering and with good accreditation according to the Education Board of Malang City. Through proportionate stratified random sampling the following three vocational high schools were chosen: SMK Negeri 6; SMK Negeri 10; and SMK Negeri 12.

For the observation instruments, the researchers had standardised checklists sourced from the BSNP [9]. The research was carried out on automotive workshop equipment consisting of special service tools, measuring tools, hand tools, general tools, trainer units, furniture and the automotive workshop area. The checklists were distributed to managers or persons-in-charge of automotive workshops in the vocational high schools under study.

RESULTS AND DISCUSSION

The results of research conducted regarding the automotive workshops in public vocational schools in Malang City are presented below.

Adequacy of Automotive Workshop Equipment at SMK Negeri 6 Malang

The level of adequacy of automotive workshop equipment at SMK Negeri 6 Malang is shown in Figure 1. This research revealed the existing equipment conditions, tools and availability compared with BSNP standards [9]. This indicates what should be provided at SMK Negeri 12 Malang:

- 1) There were 41 sets of special service tools: 29 sets were in good condition; 10 sets were slightly damaged; and two sets were severely damaged. There should be 70 sets according to the BSNP standards. The level of adequacy was 43%, meaning that the workshop was considered well equipped. For improvement, the school should equip the workshop with a bearing splitter, a bearing replacer, an oil filter spanner, valve spring compressor, hollow punch and piston ring groove cleaner.
- 2) There were 79 sets of mechanical measuring instruments available at the workshop: 45 sets were in good condition; 30 sets had minor damage; and 10 sets were severely damaged. According to the BSNP standards,

the workshop should be equipped with 60 tool sets. The workshop was considered well equipped (68% adequacy). The school should add several tools, such as a throttle-valve angular-position measurement tool, coil spring tester and oil tester.

- 3) According to the BSNP standards, the workshop should have 32 sets of electric measuring/tune-up devices. The workshop under study had 64 sets: 26 sets were in good condition; 22 sets were slightly damaged; and 16 sets were severely damaged. In summary, the adequacy was 85% and the workshop was considered very well equipped.
- 4) There were 352 sets of hand tools and general tools at the workshop: 137 sets were in good condition; 174 sets were slightly damaged; and 41 sets were severely damaged. According to the BSNP standards, a workshop should have 183 sets. This result indicated a very well-equipped workshop with 73% adequacy. Some tools that should be added are a ratchet handle, speed handle, sliding handle, offset screwdriver and cutting pliers.
- 5) The adequacy of work safety equipment at the workshop was 88%. There were 30 sets of equipment, whereas the BSNP standards require only 25 sets. The workshop was considered very well equipped, with 20 sets of equipment in good condition, five slightly damaged and five severely damaged.
- 6) The BSNP standards require every workshop to have 24 units of trainer equipment. The workshop under study had 22 units: 19 units were in good condition and 5 units were slightly damaged. Thus, it was considered very well equipped, with a 79% adequacy.
- 7) The workshop had just 17 out of 61 pieces of furniture as required by the BSNP standards. It had 13 pieces of furniture, which were in good condition; one piece was slightly damaged and three were severely damaged. The adequacy percentage was 67%, and it was well equipped. For improvement, a work table and first aid kit should be added.
- 8) The level of the adequacy of materials/workpieces for workshop activity was 61%, meaning that the workshop had a good stock of materials/workpieces.

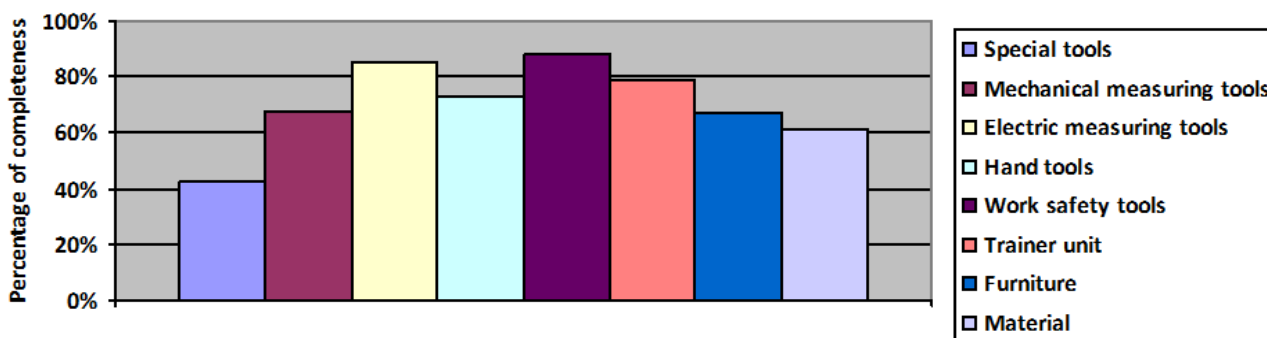


Figure 1: Graphic competitiveness automotive workshop at SMKN 6 Malang.

Figure 1 shows that the automotive workshop equipment at SMK Negeri 6 Malang can be considered very well equipped with 70% adequacy, meaning that the workshop has essential equipment for hands-on activities.

Adequacy of Automotive Workshop Equipment at SMKN 10 Malang

The level of adequacy of automotive workshop equipment at SMK Negeri 10 Malang is shown in Figure 2.

The research revealed the existing equipment conditions, tools and availability, as compared to BSNP standards [9]. This indicates what should be provided at SMK Negeri 10 Malang:

- 1) There were just 22 sets of special service tools (32% adequacy). Although all were in good condition there should be 70 sets according to the BSNP standards. The school should equip the workshop with a bearing splitter, Nepal spanner, hollow punch, piston ring compressor, piston ring expander, piston ring groove and impact wrench.
- 2) There were 59 sets of mechanical measuring instruments available at the workshop: 35 sets were in good condition; 11 sets had minor damage; and 13 sets were severely damaged. According to the BSNP standards, the workshop should be equipped with 60 tool sets. With only 56% adequacy, the school should add several tools, such as a throttle-valve angular-position measurement tool, coil spring tester, oil tester and straight edge.
- 3) According to the BSNP standards, a workshop should have 32 sets of electric measuring/tune-up devices. The workshop under study had 38 sets: 23 sets were in good condition; 3 sets had minor damage; and 12 sets were severely damaged. In summary, the adequacy was 62% and considered well equipped. Some tools that should be added are petrol engine timing light and diesel engine timing light.

- 4) The available hand tools and general tools at the workshop were 179 out of the 183 sets required by the BSNP standards; 129 sets were in good condition; 34 sets were slightly damaged; and 15 sets were severely damaged. This result indicates a well-equipped workshop with 72% adequacy. The tools that should be added are a speed handle, sliding handle, gasket scraper and spare part trolley.
- 5) The adequacy of work safety equipment at the workshop was 97% since there are 29 sets of equipment; the BSNP standards require 25 sets. The workshop was considered very well equipped, because 23 sets of equipment were in good condition; four sets were slightly damaged and two sets were severely damaged.
- 6) The BSNP standards require every workshop to have 24 units of trainer equipment. The workshop under study had 19 units: 14 units were in good condition and five units were severely damaged. Thus, it was considered well equipped, with an adequacy of 58%. The workshop should be equipped with a 4-stroke engine live diesel and 4-stroke engine dead diesel.
- 7) The workshop had just 20 out of 61 pieces of furniture, as required by the BSNP standards. It had 14 pieces of furniture, which were in good condition and six in slightly damaged condition. In summary, the adequacy percentage was 79%, and it belongs to the very *well-equipped* category. For improvement, a work table and chair should be added.
- 8) The level of adequacy of materials/workpieces for workshop activity was 64%, meaning that the workshop had a good stock of materials/workpieces.

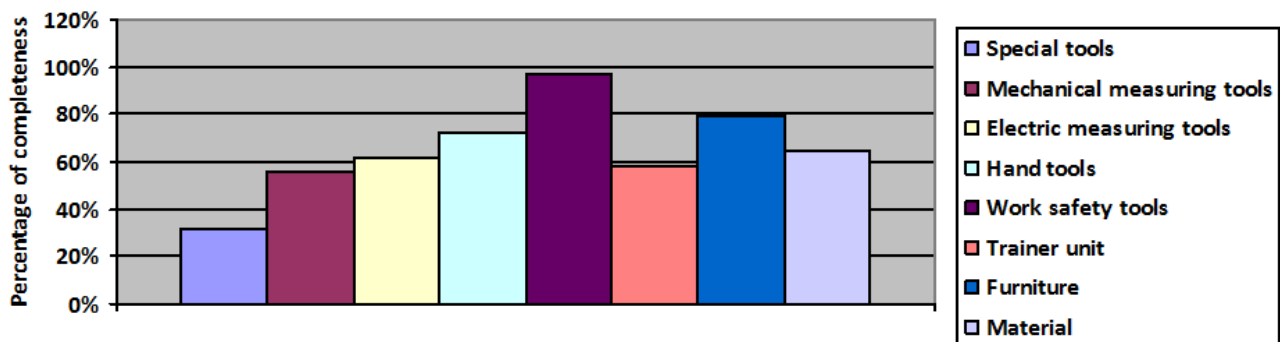


Figure 2: Graphic completeness automotive workshop at SMKN 10 Malang.

Figure 2 shows that the automotive workshop equipment at SMK Negeri 10 Malang can be considered well equipped with 65% adequacy, meaning that the workshop has standard equipment for hands-on activities.

Adequacy of Automotive Workshop Equipment at SMKN 12 Malang

The level of adequacy of automotive workshop equipment at SMK Negeri 12 Malang is shown in Figure 3.

The research revealed the existing equipment conditions, tools and availability compared with BSNP standards [9]. This indicates what should be provided at SMK Negeri 12 Malang:

- 1) There were just 54 sets of special service tools: 47 sets were in good condition; four sets were slightly damaged; and three sets were severely damaged. There should be 70 sets according to the BSNP standards. The level of adequacy was 68%, meaning that the workshop was considered well equipped. For improvement, the school should equip the workshop with a coil spring compressor.
- 2) There were 65 sets of mechanical measuring instruments available at the workshop: 52 sets were in good condition; 11 sets had minor damage; and two sets were severely damaged. According to the BSNP standards, the workshop should be equipped with 60 tool sets. The workshop was considered very well equipped (80% adequacy). The school should add several tools such as a coil spring tester and straight edge.
- 3) According to the BSNP standards, a workshop should have 32 sets of electric measuring/tune-up devices. The workshop under study had 31 sets: 26 sets were in good condition and five sets had minor damage. In summary, the adequacy was 74%, and the workshop was considered well equipped. Tools that should be added include a diesel engine timing light and scan tool.
- 4) There were 198 sets of hand tools and general tools at the workshop: 177 sets were in good condition; 19 sets were slightly damaged; and two sets were severely damaged. According to the BSNP standards, a workshop should have 183 sets. This result indicates a very well-equipped workshop, with an adequacy of 92%.

- 5) The adequacy of work safety equipment at the workshop was 67%. There were 24 sets of equipment, whereas the BSNP standards require 25 sets. The workshop was considered well equipped, because 23 sets of equipment were in good condition and one set was slightly damaged. The workshop should add a car lift and baby crane.
- 6) The BSNP standards require every workshop to have 24 units of trainer equipment. However, the workshop under study had just 14 units, although all were in good condition. Thus, it is considered well equipped with an adequacy of 58%. The workshop should be equipped with a 4-stroke engine live diesel and 4-stroke engine dead diesel.
- 7) The workshop had just 46 out of 61 pieces of furniture as required by the BSNP standards. It had 18 pieces of furniture in good condition; 24 pieces in slightly damaged condition; and five in severely damaged condition. In summary, the adequacy percentage was 77%, and it belonged to the very *well-equipped* category. For improvement, a work chair and first aid kit should be added.
- 8) The level of adequacy of materials/workpieces for workshop activity was 61%, meaning that the workshop had a good stock of materials/workpieces.

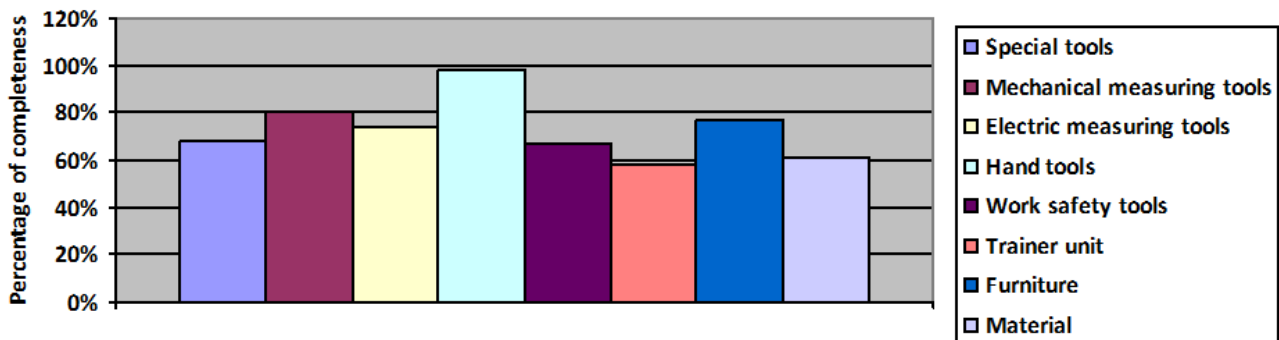


Figure 3: Graphic completeness automotive workshop at SMKN 12 Malang.

Figure 3 shows that the automotive workshop equipment at SMK Negeri 12 Malang can be considered very well equipped with 72% adequacy, meaning that the workshop has essential equipment for hands-on activities.

DISCUSSION AND CONCLUSIONS

Overall, the automotive workshop equipment in vocational high schools in Malang City satisfied the predetermined standards. The 69% adequacy, according to BAN-PT, indicates well-equipped workshops.

The provision of adequate facilities is an obligation that must be fulfilled by schools to improve the quality of graduates. Vocational education can be defined as an organised educational programme directly related to the preparation of individuals entering the workforce [3]. Hence, supporting facilities and infrastructure are necessary to facilitate students' achievements in learning.

A study on the effect of the adequacy of facilities and infrastructure on student learning revealed that adequate facilities could benefit students in learning and improve the quality of their learning. Conversely, inadequate facilities and infrastructure could adversely impact student learning [10]. One way to overcome lack of workshop equipment is to employ systematic scheduling methods to achieve an ideal student-equipment ratio. In the scheduling process the number of students, the amount of equipment and the number of rooms used should be considered. The scheduling system is beneficial by avoiding a timetable clash in the use of the workshop [11].

In accordance with the standards set by the Directorate of Technical and Vocational Education [11], an ideal workshop should have six tools and six workpieces for a group of 36 students. In many high schools, however, a workshop activity often has 40 students. To overcome the inadequacy of equipment, teachers should be able to manage the use of existing equipment efficiency to optimise student learning. A scheduling system is necessary to exploit the available equipment to the full, to serve a large number of students.

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