Physics Practicum Matter Suitability to Skills Competency Vocational Investigation In Central Java Province Indonesia

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Abstract: The investigation aims in this study were to reveal the implementation of physics practical work by the teachers and the conformity of the practical work material with the existing expertise competence in a vocational high school (SMK). This study focused on the vocational high schools in an Expertise Concrete and Stone Construction Engineering. The research method used a literature review, analysis of curriculum and research result, as well as semi-open-interview that involved about 13 SMK from 7 districts in Central Java Province, Indonesia. The Vocational High School are involved, consisted by 6 Private SMK and 7 Public SMK, with 26 physics’ teachers (N = 26). Based on the analysis result of existing curriculum in SMK Tujuh Lima 1 Purwokerto and SMK Negeri 2 Purwokerto, as well as the research results, showed that the physics practicum based expertise competence can be developed, by connected the basic competence of physics and the expertise field or productive group. The research results and semi-open interview showed that 22 teachers or 84.46% agreed, if the physics learning in SMK is supported by the physics practical work activities- expertise competency-based, using the natural sand material of Logawa River, to develop no-fines concrete technology. The description percentage of teachers’ opinion is as followed: make easy of concept understanding (19.23%), more attractive to students (3.84%), increase the creativity of students (3.84%), associate the physics material with a competence or expertise (38.46%), students can be apply the theory and the practical work (3.84%). The description percentage of teachers who do not agree were: too difficult for students (7.69%), lack of the teachers’ ability and make difficult for teachers (7.69%). The development tested of physics practical work-expertise competence requirement based in SKM Seven Five Purwokerto, equipped the students with the science process skills such as: the observable ability, the ability to interpret the results of observation, communication skill, ability to classify, predict ability, the ability to plan the study, the hypothesis explaining skill, the ability to use the tools and materials, as well as the ability to carry out the experiment.

Keywords: no-fines concrete, aggregate Logawa River, science process skill, physics practical work-skills competency requirement based

1. Introduction

Based on the mindset formulation improvement of curriculum 2013 in Indonesia, it is obtained that the Standard Competency derived from requirement, Content Standard derived from the graduate Competency Standards, through the core competencies that free subjects, and all subjects should contribute to the formation of attitude, skill, and knowledge, as well as the subject derived from the competency that want to achieve. In addition, based on the learning in curriculum 2013 emphasized on: student-centered, interactive, active-probe, real-world context, team-based learning, stimulation in all directions (all senses), multimedia tools (various educational technology equipment), multi-disciplinary knowledge (multidisciplinary approach), and Critical (required a creative thinking)

The educational expertise spectrum of vocational high school in Indonesian, consisted by six subject fields of expertise, such as: Technology and Engineering, Information Technology, and Health Communication, Arts-Crafts-Tourism, Agribusiness and Agro Technology (Agriculture), as well as Business and Management. These six studies are divided into 121 competency skills. Three from these six subject fields of expertise, supported by adaptive subjects (physics) ie Study Field of Technology and Engineering Skills, Health and Agriculture., Respectively the total hours of physics was 276 hours, 192 hours and 192 hours.

Three from the physics basic competences that printed in a curriculum of SMK, the expertise field of concrete and stone construction engineering were as following: (1) Mastering the basic concepts of physics that directly supported the competencymplementation of its expertise program, (2) Applying the basic concepts of physics to support the competency implementation of its expertise program in a daily life, (3) Applying the basic concepts of physics to develop the ability of its expertise program on the higher level. Based on these conditions, the physics learning had a role in achieving the skills program, and this matter should be an important concern for a physics teacher at SMK. But the field reality showed that the physics teacher of SMK does not correspond to the expected competencies.

According to Tan & Temiz, (2003), the fundamental purpose from the teaching science currently was to educate the students in order they can conducted the research, explore, investigate, make a connections between daily life with a topics of science, using the scientific methods in solving the problems and see the world through the scientist view. The physics learning as a part of science was essentially aimed to develop the intellectual of students' competence, such as independent learning, problem solving, decision making and critical thinking (American Association for the Advancement of Science (AAAS), 1993; National Research Council (NRC), 1996).

The process of physics learning that held by the teachers largely, have the quality of academic theoretically and less
supported by the practical work activities in the laboratory that can equipped students in understanding the concept. In addition, based on the research results of Memon, 2007 (in Faize, 2011), a science teacher was only equipped the pedagogy theoretical aspects, but it was less of emphasizing the practical work teaching methods. The equipping of teachers in conducted the practical work was very less, this impacted to the lack of teaching skill in using of practical work method. According to Utari 2010, its needed to think about how the learning process is delivered to the students, in order the science learning was able to give the effect to the expected capabilities.

On the other hand, the teachers in their profession shall to fulfill the Academic Qualifications Standards and Teachers’ Competencies as printed in the Regulation of the National Education Minister No. 16 of 2007 in Indonesia. The teacher competency standards developed completely from four main competencies: pedagogical, personality, social and professional. These four competencies integrated in the teachers’ performance, some professional competencies of physics teachers, including: understanding the concepts, laws, and physics theories, as well as its implementation flexibly, explaining the application of the physical laws in a technology related to the physics, especially that found in a daily life, creative and innovative in the application and development of the physics field and its related sciences, using the measure tool, prop, calculator, and computer software to enhance the physics learning in the classroom, laboratory and field, designing the physics experiment for the study or research purposes.

Science learning that supported by the practical work was very effective in understanding of students’ concept. The students should tried to acquire and achieve the knowledge, as well as have the science process skills (Taşdere & Ercan, 2009). Science process skills emphasised on the skill formation in acquiring the knowledge, and communicate its result. The ability to use the reason mind, and act efficiently and effectively to achieve a specific outcome, including to the creativity that defined as a skill. The equipping of science process skills can be done through the learning activities in the laboratory.

The research result of Purwandari, et al. (2012), the ability of students science process skills on the expertise competence of Concrete and Stone Construction Engineering SMK “X1” in Purwokerto was still low. The research activity that carried out by using the physics practical work- competency skill requirement based, involved the students of class X, on the subject of quantity and unit. The implementation of physics practical workused the material of natural sand aggregate of Logawa River and the test specimen of no-fines concrete. The physics practical work, by using the sand material and the test specimen of no-fines concrete have the purposes, to understand the physics concepts, but its adapted to what is being learned in the subject of inspection techniques and the implementation of concrete construction. On that stud, the science process skills that are analyzed including: the ability to observing, planning the research, explaining the hypothesis, using the tool and material, conducting the experiment. The result obtained such as, the ability to observing (38.24%), planning the research (16.56%), explaining the hypothesis (19.4%), using tool and material (12%) conducting the experiment (14.5%). Meanwhile the science process skill that included the abilities, interpreting the observe result skill, communicating skill, classifying skill and predicting skill showed the results of the average value respectively about 21.6%, 7.37%, 8.14% and 8.6%.

Physics learning should accommodated and became the base of a productive learning or expertise competence in SMK. The physics learning needed to support with the physics practical work material- expertise competency requirement based, that can be done by analysing of the existing curriculum, by linking the physics and expertise competence and the research result. The purpose of investigation in this study was to reveal the material suitability of physics practical work toward the vocational high school’s expertise competence in the provinces of Central Java, Indonesia.

2. Method

This study was an analysis of the requirement about the implementation of physics practical work, that can be developed based on the requirement of the expertise competency. The investigation conducted by identification the existing curriculum in the expertise field of Concrete and Stone Construction of SMK Tujuh Lima 1 Purwokerto and SMK Negeri 2 Purwokerto, in a adaptive group and productive group. The adaptive group was aphysic competence, while the productive group was a expertise competency that outlined in the standard and basic competencies. The identification results used as the basis of obtaining the relevance between physics basic competencies and the expertise competency or productive. The identification result and the relevancy between the competence that made by table and linked to the results of the research that produced the physics practical work material, that support the competence of Construction Techniques of Stone and Concrete. The research activity is also supported by the field observation that regarding to the existing infrastructure in SMK Seven Five 1 and SMK N 2 Purwokerto. The next stage was the semi-open written interview about the teacher's response against the development of physics practical work expertise- expertise competency requirement based, by using the natural sand material of Logawa River and technology development of No-fines Concrete. The study involved about 13 SMK from 7 districts in Central Java Province, Indonesia. The Vocational High School are involved, consisted from 6 Privates SMK and 7 Publics SMK, with 26 physics teachers (N = 26). This study is also explored the science process skill (KPS) of vocational high school’s students of class X in SMK Tujuh Lima 1 Purwokerto, on the practical work material of volume measuring of concrete cavity, by grain size variation of natural sand aggregate, diametered of 9 mm, 5 mm, 4 mm and 2 mm. The instruments used in the study are as followed: 1. The semi-open question about the SMK’s physics teacher responses, 2. The practical work module of measuring and calculating the cavity volume of no-fines concrete.

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3. Result and Discussion

Based on the analysis of existing curriculum in SMK 2 and SMK Seven Five 1 Purwokerto, stated that the physics competence in SMK, especially in expertise field of Concrete and Stone Construction Engineering, consisted by several Competency Standards, that are then presented in the Basic Competence. The identification of physics competency standard that can be attributed to the expertise competence are included: 1. Measuring the amount and applying the unit, 2. Interpreting the mechanical property of the materials, 3. Applying the concept of temperature and kalor, 4. Applying the concept of temperature and kalor, 5. Applying the concept of fluid, 6. Applying the vibration, wave, and sound. The explanation of competency standard, to the physics basic competence, included; 1. mastering the concept of scale and unit, 2. Using the appropriate measuring instrument to measuring a physical quantity, 3. Mastering the concept of temperature and kalor, 4. Mastering the influence of kalor to a substance, 5. Measuring the temperature and kalor, 6. Calculating the kalor, 7. Calculating the vibration, wave, and sound.

Identification of skill competency (productive group) that identified, can be linked to the physics competence, consisted by three competency standards, that set out by the six core competencies. The competency standards that shall, included: 1. Examination Technique and Implementation of Concrete Construction, 2. Building Material Science, 3. Implemented the concrete casting, which is described in the core competencies, as followed: 1. Checking the building materials, 2. Describing the building materials of stone and concrete, 3. Making a light concrete mix. From the curriculum analysis of SMK, the ExpertiseConcrete and Stone Construction Engineering (between the physics competence and productive competence group) and a literature review of research results that related to technology of no-fines concrete, so it was developing a physics practical work material- expertise competency requirements based, as followed: 1. The attenuation of sound waves, 2. The density and specific gravity of the aggregate, 3. The density and specific gravity of no-fines concrete bricks wall material, 4. The thermal conductivity of no-fines concrete brick wall material, 5. The rate of kalor flow of no-fines concrete bricks wall material, 6. The power temperature insulation of no-fines concrete brick wall material. Its completely set out in Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Competency Standard</th>
<th>Expertise Competency</th>
<th>Physics practical work- TKBB requirement based</th>
<th>Research Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Measuring the amount and applying the unit</td>
<td>1.</td>
<td>Measuring the specific mass and aggregate specific quantity</td>
<td>The Development of manufacturing technology of No-fines’ light concrete by using the dust waste of rice husks and krisik gravels used as spouses of noise reduction wall and temperature isolation. (Purwandari, R.D., compete grant of, DIKTI, First Years 2009)</td>
</tr>
<tr>
<td>3.</td>
<td>Applying the concept of temperature and kalor</td>
<td>3.</td>
<td>The Development of manufacturing technology of No-fines’ light concrete by using the dust waste of rice husks and krisik gravels used as spouses of noise reduction wall and temperature isolation. (Purwandari, R.D., compete grant of, DIKTI, First Years 2009)</td>
<td></td>
</tr>
</tbody>
</table>
| 4.  | Applying the concept of temperature and kalor | 4.  | The nature study of rice husk dusts as the application of chloride acid as the Pozzolana materials to improving the concrete’s
SMK that involved in this study, amount 13 schools that selected randomly and scattered in the southern part of Central Java province. The most western Locationin Cilacap district, bordered with West Java province, meanwhile the most easternwas in Sragen bordered with East Java Province. The totally of SMK are consisted byseven publicsSMK and six privatesSMK. The purpose of choosing SMK randomly in seven districts was in order the data obtained, representing the whole teachers’ opinion. SMK that involved to be focussed on the Expertise concrete and Stone Construction Engineering. from the seven districts, there was only Klaten district that has four SMK and have an expertise field of Concrete and Stone Construction Engineering. For the Detailed description of SMK’s names and the districts’ names, explained in the Table 2.

Table 2: Vocational High School, expertise field of Stone and Concrete construction technique in Central Java, Indonesia

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of School</th>
<th>Type of School</th>
<th>Regency Area and Postal Code</th>
<th>Number of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SMK Negeri 2 Purwokerto</td>
<td>Public</td>
<td>Banyumas, 53116</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>SMK Negeri 1 Klego</td>
<td>Public</td>
<td>Boyolali, 57385</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>SMK Negeri 1 Wanareja</td>
<td>Public</td>
<td>Cilacap, 53265</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>SMK Negeri 2 Cilacap</td>
<td>Public</td>
<td>Cilacap, 53212</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>SMK Negeri 2 Kebumen</td>
<td>Public</td>
<td>Kebumen, 54315</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>SMK Negeri 1 Purworejo</td>
<td>Public</td>
<td>Purworejo, 54101</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>SMK Negeri 2 Sragen</td>
<td>Public</td>
<td>Sragen, 57212</td>
<td>1</td>
</tr>
<tr>
<td>8.</td>
<td>SMK Tunggal Cipta Manisrenngo</td>
<td>Privat</td>
<td>Klaten, 57485</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>SMK Kristen 1 Klaten</td>
<td>Privat</td>
<td>Klaten, 57417</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>SMK YPP Purworejo</td>
<td>Privat</td>
<td>Purworejo, 54171</td>
<td>2</td>
</tr>
<tr>
<td>11.</td>
<td>SMK Muhammadiyah 4 Klaten Tengah</td>
<td>Privat</td>
<td>Klaten, 57419</td>
<td>2</td>
</tr>
<tr>
<td>12.</td>
<td>SMK Tjuh Lima 1 Purwokerto</td>
<td>Privat</td>
<td>Banyumas, 53143</td>
<td>2</td>
</tr>
<tr>
<td>13.</td>
<td>SMK Muhammadiyah 1 Klaten Utara</td>
<td>Privat</td>
<td>Klaten, 57434</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Amount of Teachers</td>
<td></td>
<td></td>
<td>26</td>
</tr>
</tbody>
</table>

The teachers who involved in the semi-open- written interview activity, consisted by12 male teachers and 14 female teachers, with the teachers’s working masses, between 3 years-34 years. the academic qualification was 88.46% of undergraduate and 11.53% was the graduates of S2. From the whole teachers who involved, about 84.61% were the teachers with the academic graduates formundergraduate of education, meanwhile, about 15.38% were non-educational graduate. The results of written interview about the teacher's response towards the development of the physics practical work, used the natural sand materials and technology of no-fines concrete, it is obtained the results as describing in Table 3.
Thedevelopmenttrial of physics practical work, appropriated with the expertise field or in this study is called as the expertise competency requirement based in SMK Seven Five 1 Purwokerto, had been done. The one of practical work material that carried out, was measuring and calculating the volume of no-fines concrete cavity, by using the density of water. In this activity, beside the physics application against the expertise field, was also make easier the comprehension of concepts and equipped the students with the science process skill. The practical work by using the concrete specimen of cylinder-shape’s no-fines, by height size about 16 cm and diameter cylinder about 10 cm. The trial specimen material of no-fines concrete by using aggregate of Logawa River with the grain size variation of natural sand’s aggregate, diametered about 9 mm, 5 mm, 4 mm and 2 mm. The science process skill that be procured, are included: the ability of observing, the ability of interpreting the observation result, communicating skill, ability to classifying, the ability of predicting, the ability of planning the study, the capability of hypothesis explaining, the ability to using the tools and materials, as well as the ability to conducting the experiment.

4. Conclusion

The conclusions that can be explained from this requirement analysis phase were:
1. The physics learning at Vocational High School, should not only in a academic theoretical, but it should be supported by the practical work, that can facilitated the students in understanding the concept, providing the hands-on practice’s experience to the students, equipping with the science process skill and can developing a scientific attitude.
2. In order the physics practical work can support its function as the supporting the achievement of expertise competency, it was necessary thematerial that can be developed based on the analysis of the curriculum, that is connected the physics basic competency and basic competence of another expertise field or productive group, the literature review of research results, the technology that is being developed and local potency that can be utilized.
3. The physics practical work–expertise competency requirement based, was consistent with the basic learning of curriculum 2013 in Indonesia, that emphasized on: student-centered, interactive, active-probed, real-world context, team-based learning, stimulation in all directions (all senses), knowledge plural disciplines (multidisciplinary approach), and critical (requiring by creative thinking).

5. Suggestion

The physics’ teacher of Vocational High School must be really understood that students be more easily to understand the physics concepts, through the practical work activity, in addition the physics competence has a function to support the expertise competency. Another thing that is needed to be noted that the physics practical work in SMK, needed to be held the mapping of the materials, in order its to be appropriated with the requirement of the expertise competency. This matter that was underlying the needs of SMK’s physics teachers, to receive the training about the implementation of the physics practical work that was appropriated with the competence field in a Vocational High School, in order to improve the teacher’s competence and understanding of the teachers in implementing the physics learning.
References


Author Profile

Ristiana Dyah Purwandari, Is a doctoral candidate in theScience Education Program, Indonesia University. The master of science she obtained from Gajah Mada University in 2006, while the science degree she obtained from Technology Institution of Sepuluh November Surabaya in 1994. Since 199 until now, she taught in Muhammadiyah Purwokerto University. Some of her research that had been conducted namely: the Physics Characteristics Analysis of No-Fines Concrete, by using the material of Aggregate of Logawa River-Natural sands, the increment of rice husk dusts as the result of implementation with chloride acid on the amount of cement to increase the quality of concrete. The research that being conducted is entitled the Development of Physises Teacher’s Skill of Vocational High School in Planning the Practical Work-Expertise Competence Requirements Based.

Anna Permanasari, Professor on analytical chemistry, a lecturer in chemistry education Department of Science and Mathematics Faculty –Indonesia University of Education since 1983. Since she do her research in adsorbent for organic and inorganic residues, she also involve in science educational research. Some doctorate students of science education program of graduate school were under her supervision.The field of research in education is on science literacy.

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