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Research paper

Learning Needs Analysis of Vocational High School`S Chemical Subjects in Mechanical Engineering Department

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Abstract

Learning chemistry material is not enough to support the competence of vocational high school students because of material which is not applicable to the world of work. The purpose of this study is to reveal the scope of learning Chemistry of vocational high school at Department of Mechanical Engineering. This research used quantitative descriptive with a with a sample of 95 respondents. The research instrument used a questionnaire which has been declared valid and reliable. The data Analysis used the level of achievement of respondents and the degree of achievement. Based on the results of research, learning chemicals subject, which is needed by the vocational high school students majoring Mechanical Engineering, consists of (1) 23 basic learning competencies, (2) 61 learning materials, (3) six learning models application, (4) two learning approaches, (5) 13 learning methods, (6) five visual learning media and 4 project motion media, and (7) four aspects of cognitive assessment and four aspects of skills assessment. From these findings, it can be recommended as a reference on learning chemistry in vocational high school students majoring mechanical engineering.

Keywords: *Needs Analysis; Learning Chemistry*

1. Introduction

Vocational training is an education program that is held directly associated with the preparation of the individual in the face of future work and career development required, (1). Vocational high school (SMK) is part of vocational education. Education is the means to prepare students for the world of work, it must be future-oriented, (2) , socialize people into attitudes Appropriate for the world of work, orientate people to understand the world of employment and to prepare for the choices and the transition they will have to make up on entering it, prepare them with specific skills and knowledge to apply in a direct way after entering employment. Vocational high school graduates should have been ready to work, smart, had a competitive advantage, comparative and strong character as a professional worker.

Based on the observations and experience in the field where the researchers are learning executor of Chemistry at the school, found some things that become the foundation of the problem. Some of the problems that arise in the learning process, among others, related to learning materials. Learning chemistry materials used in the vocational high school are more likely the same as in general high school (SMA). There is no difference between SMK and SMA, in particular. It can be seen in the material presented which is stated in the syllabus of learning Chemistry. The learning chemistry which is not specified cause various problems, among others such as; the difficulty of integrating the material with the real conditions of each student competence especially machining competence. It will affect the students' motivation. Learning materials which are difficult to be integrated with learning competencies are confusing the students. It is reducing the students' learning motivation. Learning is the process of obtaining mastery, knowledge, habits, which is obtained from the process of learning, (3). The knowledge that is obtained in the form of facts, concepts, procedures, and principles of students characteristic can do so by involving interaction with the external environment that can change someone's behavior, (3-5).

Some materials are hard to pin down in a program related to Mechanical Machining expertise such as; the electrolyte and non-electrolyte solution, Reaction Oxidation Reduction, the Basic Law and calculation of Chemistry, Electrochemistry, Hydrocarbons and Petroleum, the rate of reaction, chemical equilibrium, acid solution Bases, Colloids, Carbon Compounds. Material presented tend to be general even only lead to certain scientific competence, in this case to the competence of electronics.

2. Literature Review

Vocational competence in learning chemistry application in the industry should provide tangible benefits. Holman (6) states that the company also has a tough challenge in realizing the company's development in the future. There are six keys identified as an obstacle that needs to be addressed, namely: a). Establishing clear training and career pathways to technician roles., b). Overcoming Difficulties faced by employers in recruiting technicians, c). Developing technicians within the workplace, d). Establishing and maintaining the quality of work-based training and vocational courses, e). Ensuring the sustainability of the technical training landscape, f). Raising awareness of chemical science Apprenticeships.

Constraints on the world of work mentioned above, it should make an input for vocational education, in order to teach and improve the competence areas of their expertise. Holman (6), "It is essential that the development of vocational education takes into ac-

count the current and likely future needs of society and employers and the wealth of research evidence on the types of learning experiences that enable students to fulfill their potential". It is supported by Lewis (7) who state that Closer collaboration between employers, and between employers and educational institutions, might help to aggregate demand from employers so that student numbers exceed the minimum required to make it worthwhile for universities/colleges to offer the relevant modules.

Rogalski (8) propose three categories of labor requirements in industrial chemistry, they are; a) Skills required for low-skilled workers, b) Skills needed for skilled workers, and c). Skills needed for young chemical engineers. To illustrate the importance of the need to apply chemicals in the work can be seen in the first level of competence. Rogalski (8)argues that the first level, workers should have the competence which involves the application of knowledge in the implementation of activities of daily work, such work is routine work carried out and planned in advance. VanAntwerp, VanAntwerp, Vander Griend, & Wentzheimer,(9) state that Additional chemistry was added to the engineering curriculum to better address its increased importance to the challenges today's engineers face in the workplace. Materials chemical additives need to be included in the curriculum to meet the increasingly challenging job. Additional chemical materials to meet the competencies in the fields of employment as (9) propose are; a). Solid state chemistry and crystal structures, b). Diffusion, c). Mechanical properties of metals, d). Phase changes: Phase diagrams, e). Physical properties of solutions (including alloys), f). Polymer structures and properties, societal issues in Materials Science; g). Fatigue and fracture, h). Chemical equilibria, i). Case studies of chemical equilibria, j). Acids and bases, k). Acids, bases, and solubility, l). Electrical properties; Semiconductors, and m). Superconductors. Based on the problems already mentioned, the purpose of this study was to reveal the learning chemistry component in the Department of Mechanical Engineering and chemical materials that must be mastered by students of vocational high school graduates at Department of Mechanical Engineering in the Riau Islands. Indonesia.

3. Methodology

Type of this research was descriptive quantitative, through DACUM (Developing a Curriculum) approach. Norton (10) and Hartanto, Lubis, & Rizal (11) state that (a) Expert workers can describe and define their job/occupation more accurately than anyone else, (b) An effective way to define a job/occupation is to precisely describe the tasks that expert workers perform, and (c) All tasks, in order to be performed correctly demand the use of certain knowledge, skills, tools, and positive worker behaviors.".

"The study sample was 95 respondents by using simple random sampling. It is consisting of the Department of Vocational Teachers of Mechanical Engineering, Chemistry Vocational Subject Teacher, Practitioner of Job field of Machining Industry, Expert/Lecturer in Chemistry for the vocational high school of Mechanical Engineering. The research instrument used was a questionnaire analysis which is based on the prepared blueprint in accordance with the needs of learning chemistry materials in schools and industry. Validity and reliability of research instrument using expert judgment consisting of five experts.

4. Results and Findings

Based on the research and the level of achievement of respondents, there are 29 variables recommended in learning chemistry to be mastered by students majoring Mechanical Engineering at vocational high school. They are; (1) 23 basic competencies of learning chemistry, (2) 61 learning materials of chemistry, (3) six applications learning model that can be applied in teaching chemistry, (4) a learning approach for teaching chemistry which consists of two approaches, (5) Chemical and general learning method that consists of 13 recommended methods, (6) Media that consists of 5-visual media and 4 motion media project, (7) aspects of assessment which is consisting of 4 ratings and 4 assessment of cognitive skills. Recommendations of this analysis are intended it is a required component of learning chemistry and must be mastered in chemistry to improve the competence of students who are majoring Mechanical Engineering, in accordance with the needs of industry and the world of work and education. Needs analysis of learning chemistry which conducted in this study is one way to find out the gap to the problem of learning competencies of Chemical faced by students in the working world. Needs analysis is one way to provide an overview or recommendations about the real needs in terms of employment, and is therefore expected competencies can be specifically known in accordance with the requirements, (11) "There are some skills that are specific to needs in industry and manufacturing, the skills need will be very important as defense to the face of the information development and the environment rapidly". 29 major items are needed in learning chemistry in vocational Department of Mechanical Engineering. From the findings of the analysis of learning needs of Chemistry at Department of Mechanical Engineering are recommended as below:

4.1. 23 Basic Competence of Learning Chemistry:

(1) Understanding the role of chemistry in life, (2) Analyzing the structure of the atom by atom model of Bohr and modern atomic theory, (3) Analyzing relationships of electron configurations to determine the location of elements in the table, (4) Understanding the process of the formation of ionic and covalent bonding, and metal bonding and interaction between particles (atoms, ions, molecules) of matter and its relationship with the physical properties of the material, (5) Analyze the nature of the electrolyte solution and a nonelectrolyte solution based on electrical conductivity, (6) Analyzing the development of the concept of reduction-oxidation reactions and determine the oxidation numbers of atoms in a molecule or ion, (7) Applying the IUPAC rules for naming simple inorganic and organic compounds, (8) Applying the concept of relative molecular mass, chemical equations, basic laws of chemistry, and the concept of the mole to complete chemical calculations, (9) Understanding the phenomenon or process that occurs in instances voltaic cells used in life, (10) Analyze the factors that influence the occurrence of corrosion and proposed the idea/ideas to overcome, (11) Understanding the phenomenon or process that occurs in an electrolysis cell sample used in life, (12) Analyzing the structure and properties of hydrocarbon compounds based on the peculiarities of carbon and its compounds classification, (13) Understanding the process of formation and separation techniques petroleum fractions as well as its usefulness, (14) Understanding the impact of the combustion of hydrocarbons to the environment and health as well as how to handle it, (15) Distinguishing exothermic reaction and endothermic reaction based on results of the experiment and the energy level diagram, (16) Understanding ΔH reaction through Hess's law, (17) Understanding the theory of collision to describe chemical reactions, (18) Analyzing factors that affect the rate of reaction, (19) Analyzing factors that affect the equilibrium shifts toward industrial applicability, (20) Analyzing the nature of the solution based on the concept of acid-base and/or pH of the solution, (21) Analyzing the role of colloids in life by its properties, (22) analyzing the structure, nomenclature, properties, and uses of carbon compounds (haloalkane, alkanol, alkoxy alkanes, aldehyde, alkanol, carboxylic acid, an alkyl alkanoate, and (23) Safety Work in the field of Chemistry.

4.2. Learning Materials of SMK Chemistry Subject

(1) The position of Chemistry in science, (2) The Nature of science of Chemistry, (3) The Role of Chemistry, (4) Bohr Structure and quantum mechanics, (5) The configuration of electrons, (6)

Atomic Number and mass number, (7) Isotope, isobars, isoton, (8) The system Periodic Elements (class and period), (9) Lewis structure, (10) Ionic bond and covalent bonds, (11) Covalent coordinates bond, (12) Metal bond, (13) The energy between molecules, (14) physical compounds properties, (15) Electrolyte properties and non-electrolyte solution, (16) Concepts oxidation-reduction reactions, (17) The oxidation number of elements in a compound or ion, (18) Compound nomenclature, (19) Relative molecule mass, (20) The equation of Reaction, (21) chemical basis law (Lavoisier's Law; Law of Proust; Dalton's Law; Law of Gay Lussac; Avogadro's Law), (22) empirical and molecular formulas, (23) Hydrate compound, (24) Concepts mol, (25) Concentration Solutions (molarity, molality, and mole fraction), (26) Chemistry calculation, 27). Volta Cell, (28) Corrosion, (29) Electrolysis, (30) Compounds hydrocarbons (Identification atom C, H, and O), (31) The uniqueness of carbon atoms, (32) Atom C primary, secondary, tertiary, and quaternary, (33) Structure of alkanes, alkenes, and alkynes, (34) Physical properties of alkanes, alkenes, and alkynes, (35) Hydrocarbons reactions, (36) Crude oil, (37) Petroleum fraction, (38) Gasoline quality, (39) Combustion impact of fuel and how to cope, (40) hydrocarbons compound in everyday life, (41) Exothermic and endothermic (Thermochemical) reaction, (42) Enthalpy reaction changes, (43) Hess's Law, (44) energy is a bond, (45) Calorimetry, (46) Collision Physical (Thermochemical), (47) Determinants factors of the reaction rate, (48) Reaction order and the reaction rate equation, (49) Dynamic equilibrium, (50) Shifting toward equilibrium, (51) equilibrium constant (Kc and Kp), (52) The development of the concept of acids and bases, (53) Indicator, (54) pH weak acids, weak bases, and pH of strong acids, strong bases, (55) Colloids properties, (56) Colloid creation, (57) The role of colloids in everyday life and industry, (58) Properties and Identification of carbon compounds, (59) tool is protective Chemistry, (60) Safety Chemistry equipment application, and (61) Types of alarm.

4.3. Learning Chemistry Models:

(1) The Direct learning model (direct instruction), (2) The Cooperative learning model (cooperative learning, (3) The model of contextual learning (Contextual Teaching and learning), (4) The model of Guided discovery learning (discovery learning), (5) The model of Problem-Based Learning, and (6) The model of Project Based Learning.

4.4. Learning Chemistry Approach:

(1) Teacher-Centered Approach (Teacher Center), and (2) Student-Centered Approach (Student Center)

4.5. Learning Chemistry Methods and General Learning Methods that can be used as a Method of Teaching Chemistry

(1) Lecturing, (2) Discussion, (3) Demonstration, (4) Recitation (creating a resume), (5) Experimental, (6) study tours/ travel works, (7) Skills training, (8) Team Teaching (more than one educator), (9) Peer Teaching (teaching fellow), (10) Problem Solving (Troubleshooting), (11) Project (designing projects), (12) Taileren (Teaching partially spliced others), and (13) Global Method (students read through the material)

4.6. Media of Learning Chemistry:

(1) Graph, (2) Diagram, (3) Chart, (4) Chart, (5) Posters, **(**6) The film, (7) Television, (8) Video (VCD, DVD, VTR), and (9) Computers (PowerPoint).

4.7. Aspects of Chemical Learning Assessment:

(1) Knowledge aspects; (a) The written test in the form of objective/multiple choice, (b) Written tests shaped outlines/essay, (c) Oral tests, (d) Assignment, **(**2) Aspects of Skills; (a) Practice, (b) Products, (c) Project, and (d) Portfolio.

5. Conclusion

Coverage of learning chemistry of Vocational high school at Mechanical Engineering Department consists of 29 variables learning chemistry, namely: (1) There are 23 basics learning competencies of learning chemistry, (2) There are 61 learning chemistry materials at Mechanical Engineering department, (3) There are six applications of learning model that can be used in teaching and learning chemistry, (4) A learning approach to teaching chemistry consists of two approaches, (5) Chemical and general learning method that consists of 13 recommended methods, (6) Media that consists of 5-visual media and 4 motion media project, and (7) Aspects of assessment consists of 4 cognitive assessment and 4 skills assessment.

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