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# Diagnostics of hydrostatic power transmission on hydraulic excavators, using work fluid analysis

*Almir Osmanovic, Elvedin Trakic, Bahrudin Saric, Mirza Hadzismajlovic, Mirza Becirovic*

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**Abstract**

The development of hydraulic systems and their exploitation certainly relies on the use of modern equipment that is more complex and productive. The breakdown of such equipment is very expensive, so the basic task of good use of the equipment is safe and efficient maintenance. The main goal is keeping hydraulic systems in the right working condition with a high level of reliability and productivity. Oil pollution is the main culprit for 70% of all irregularities in operation of hydraulic systems. It causes damage which results in lower system reliability, increased power consumption and reduced lifetime of components. Impact of impurities in the system is a source of new pollution, so this problem exponentially increases with time. In order to prevent the consequences, it is necessary to protect it with an appropriate oil pollution control and control system. The development of the technique has provided precision oil analysis methods, and numerous studies point to the importance of maintaining a high performance fluid in hydrostatic power supply units in mobile machines. In addition to the reliability and longevity of the system, these activities contribute significantly to protecting the environment and reducing maintenance costs.

**Key words:** oil systems, maintaining of oil, oil filter, oil filtration, ecology, oil analysis, energy, hard particles, mobile machine, hydrostatic power

## 1. Introduction

Hydraulic systems are the basis for the design of modern mobile machines with advantages over other types of drives and transmissions such as: quiet and silent adaptation to load changes, simple overload protection and high utilization coefficient. The design of hydraulic systems is a challenge, due to the increasing demands for performance and the economics for the application of this systems. Furthermore, these systems are designed to increase reliability and robustness, as well as to reduce errors. Failure to appear in these systems is very common because of impurities. With the loss of stability in the systems, large oscillations of pressure occur with reducing the usability of hydraulic systems [1].

The exploitation conditions, the management mode and the available space for installation have made it possible to develop special constructions of hydraulic systems, i.e. hydrostatic power transmission in mobile machines. In complex mobile machines of modern constructions, hydraulic system solved a problem that could not be solved mechanically. Hydraulic systems have a large application of power transfer primarily because of their compactness, rigidity, relatively small mass, the transfer of large forces (moments).

## 2. Hydraulic systems in mobile machines

Components of a hydraulic system, functionally connected with appropriate lines, construct a hydraulic fluid flow system. Depending on the flow of fluid which is circulates in the system, they are principally performed as open and closed.

In the open hydraulic system, the working fluid is brought from the tank to the actuator by a hydraulic pump and from the actuator returns to the tank. A functional scheme of such a system is shown in Figure 1.a. With open hydrostatic systems, actuators can be hydraulic cylinder or hydraulic motors. The tank has an increased volume corresponding to the multiple value of the maximum hydropower flow rate. This results in the calming and cooling of the working fluid returning to the reservoir. In closed hydraulic system, the fluid flows from the hydraulic pump to the hydraulic motor and from the hydraulic motors back to the hydraulic pump. A functional scheme of such a system is shown in Figure 1.b. The tank in this case unlike the open circle is smaller and adapted to the flow of the hydraulic pump and the volume of the system [2].

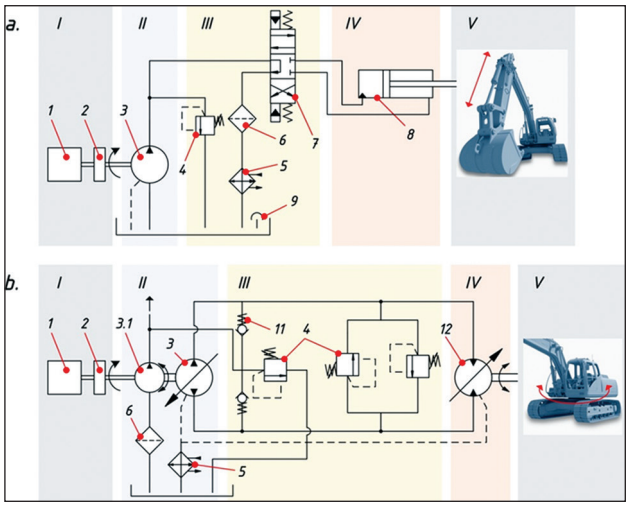


*Figure 1. Hydraulic system: a) Open, b) Closed*
*1-Motor engine, 2-elastic coupling, 3-hydraulic pump, 3.1-servo hydraulic pump, 4-safety valve, 5-fluid cooler, 6-filter, 7-hydraulic valve, 8-hydraulic cylinder, 9-hose, 10 -support valve, 11-hydraulic motor [2].*

Pressure in the system is the most important parameter when selecting hydraulic system. By the pressure level they are classified into systems with low pressure up to $16 \cdot 10^5$ [Pa], medium to $25 \cdot 10^5$ [Pa] and high up to $42 \cdot 10^5$ [Pa]. For the same hydraulic power, the choice of greater pressure requires less flow in the system or smaller components so that the system becomes more compact and lighter. On the other hand, with the increase in pressure, the losses and the noise increase and the life of the system is reduced.

## 3. Hydrostatic transmission power in mobile machines

Drive systems of mobile machines - hydraulic excavators of all sizes are completely based on the same hydrostatic principle. However, the structure of the drive systems varies depending on the size, mass and configuration of the hydraulic excavator. Figure 2 shows schematic hydraulic systems with basic components [3].

The mobile machine used for research in this work is hydraulic excavator - caterpillar, which is shown in Figure 3.

The basic characteristics of these mobile machines are great usability. They are part of a group of medium hydraulic excavators that have the ability to dig under and above the booth on which they stand. These hydraulic excavators also belong to a group of universal hydraulic excavators with a volume of bucket - 1.1 $m^3$.

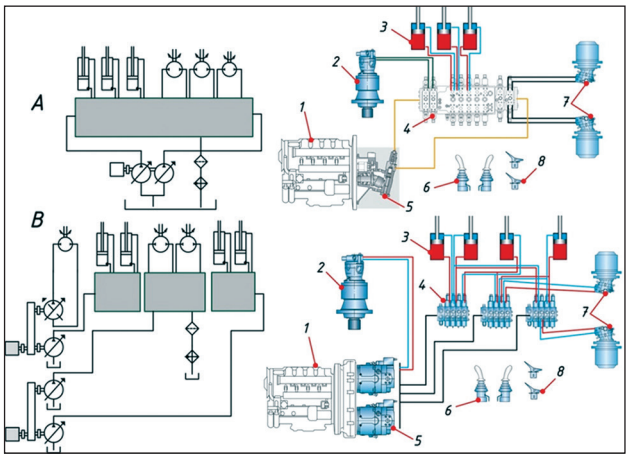


*Figure 2. Medium and large hydraulic excavators*
*1-Motor engine, 2-hydraulic motor, 3-hydraulic cylinder, 4-hydraulic valve, 5-hydraulic pump, 6- electro-hydraulic command valve, 7-hydraulic transmission, 8- electro-hydraulic command valve*


*Figure 3. Mobile machine hydraulic excavator caterpillar*

## 4. Hydrostatic Power Transmission Analysis in Mobile Machines

Hydraulic excavators are derived from combined mechanical-hydrostatic drives and systems. With the aim of optimum utilization of the installed power, the motor drives of the axial-piston pumps with servo-hydraulic control. Hydraulic pumps are connected to the hydrostatic system and with actuators hydraulic motors and hydraulic cylinders that serve for the: driving mechanism, the rotation of the excavator, the lifting and lowering of the excavator boom etc.. The technological process of these machines is characterized by: changing the load level in wide limits, a large number of

changes in direction of movement, switching on and off of individual drives in a unit of time, working in changing conditions of digging resistance and geomechanical stability. In designing these hydraulic excavators, the modular principle of construction and design was applied to the components and systems [4].

During the exploitation of the hydraulic excavator, there are possible interruptions and congestions, which are:

- increased noise,
- mechanical oscillations,
- Striking and structural instability when starting work and stopping,
- oscillation in pipelines and their damage,
- Insufficient pressure in the system or lack of pressure,
- pressure fluctuations,
- loss of oil from the pressure side,
- the flow is too small or does not exist at all,
- too high viscosity of oil fluid at low temperatures etc.

## 5. Procedures for monitoring the status of a mobile machine

Analysis of working fluid is a widely-used and efficient tool for monitoring the status of a mobile machine. There are a large number of different tests used to analyze hydraulic oil as a working fluid used for mobile machines. From the aspect of working fluid analysis, special attention should be paid to the change in the number of metal particles in the working fluid and the water content. In this paper work is analyzes the hydraulic oil by determining the number of solid particles in the working fluid. Some of the tests to monitor the condition of the mobile machine by analyzing the working fluid are shown in Table 1. Using hydraulic oil condition analysis, it is able to replace the oil before serious damage of the mobile machine.

Particle Specification is the procedure for determining the number of solid particles in the hydraulic oil and their classification according to the number defined according to ISO 4406 (Table 2). An excessive amount of solid particles in the working fluid or in the system itself weakens the ability to form an oil film between the moving parts resulting increase wear and friction, and generation of a significant amount of heat.

*Table 1. Shows oil analysis parameters and the technologies used to measure them [5]*

| Category | Engines | Rotating Machines |
|---|---|---|
| Machine wear | Fine wear metal elements | Rotating Disc Electrode (RDE) Spectroscopy, Inductively Coupled Plasma (ICP) Spectroscopy |
| | Large wear metal elements | FPQ-XRF*, Acid digestion ICP |
| | Particle count and distribution | Light blocking*, light scattering, laser imaging (LNF)* |
| | Wear particle shape analysis | Laser imaging (LNF)*, Ferrography* |
| Contamination | Yes, mostly dissolved water | Yes, dissolved and free water |
| | Sand and Dirt | Light Blocking*, Light Scattering, Laser Imaging (LNF)* |
| | Fuel Dilution | Fuel Sniffer*, Gas Chromatography (GC), Gravimetric |
| | Water/Moisture | Infrared (IR)*, Karl Fischer Titration (KF) |
| | Glycol/Coolant | IR |
| | Soot | IR*, gravimetric |
| | Alien Fluid | IR |
| Degradation | Oxidation, Nitration, Sulfation | IR |
| | Viscosity | Viscosity |
| | Acid Number (AN), or Base Number (BN) | Titration, IR |

*Table 2. Classification of hydraulic oil purity according to ISO 4406*

| ISO code number | Number of particles per 100 ml. sample | |
|---|---|---|
| | More then | Up to |
| 24 | 8 000 000 | 16 000 000 |
| 23 | 4 000 000 | 8 000 000 |
| 22 | 2 000 000 | 4 000 000 |
| 21 | 1 000 000 | 2 000 000 |
| 20 | 500 000 | 1 000 000 |
| 19 | 250 000 | 500 000 |
| 18 | 130 000 | 250 000 |
| 17 | 64 000 | 130 000 |
| 16 | 32 000 | 64 000 |
| 15 | 16 000 | 32 000 |
| 14 | 8 000 | 16 000 |
| 13 | 4 000 | 8 000 |
| 12 | 2 000 | 4 000 |
| 11 | 1 000 | 2 000 |
| 10 | 500 | 1 000 |
| 9 | 250 | 500 |
| 8 | 130 | 250 |
| 7 | 64 | 130 |
| 6 | 32 | 64 |
| 5 | 16 | 32 |
| 4 | 8 | 16 |
| 3 | 4 | 8 |
| 2 | 2 | 4 |
| 1 | 1 | 2 |

## 6. Work fluid analysis

There are two ways and approaches to analysis working fluid by taking working fluid samples from:

- reservoirs /tank and
- pipeline system for the excavator mechanisms for rotating excavators, lifting and lowering of hydraulic excavator boom.

In this paper the experimental determination of the working fluid is carried out taking samples-hydraulic oil from the reservoir. The number of solid particles in the system largely depends on the finesse of working fluid filtration, which prevents machine cell failure. Currently used filters retain 90 to 93% of all solid particles, which are greater than the given nominal fineness.

Appearance of solid particles, significantly reduces possible working life for most hydraulic devices. Fine dirt has the greatest impact on the wear of parts. Table 3 shows the requirements for individual components of hydraulic systems with regard to the number of solid particles in relation to the working pressure of the system. The ISO 4406 standard defined cleans the oil purity by three code numbers (x / y / z) which are determine the number of solid particles. The first being the number of particles larger than 4 μm, the second particle size greater than 6 μm and the third largest particle of 14 μm in an oil sample.

Testing or determination of the number of solid particles in the CAT hydraulic oil (HYDO) SAE 10W used in the Caterpillar hydraulic excavator was performed using the PARKER icountOS - oil sampler (Figure 3).

At the heart of the system is a sophisticated laser detector, using a light obscuration flow cell, providing continuous measurement of fluid flow passing through a sample tube. Measurements are taken every second as standard, although measurement intervals and test period can be defined by the user, with results being reported immediately and updated in real time. Data is displayed on a built-in OLED digital display and can also be stored for subsequent upload via the embedded icount's web page interface connecting through an RJ45 cable.


*Figure 4. Hydraulic oil tester (Parker icountOS - oil sampler)*

*Table 3. Hydraulic oil purity according to ISO 4406 [6]*

| Most Sensitive System component ISO | Low/Medium Pressure under 150 bar | | High pressure from 150 bar up 250 bar | | Very high pressure from 250 bar | |
|---|---|---|---|---|---|---|
| | ISO Target levels | Micron ratings | ISO Target levels | Micron ratings | ISO Target levels | Micron ratings |
| Pumps | | | | | | |
| Fixed gear or fixed vane | 20/18/15 | 20 | 19/17/14 | 10 | 18/16/13 | 5 |
| Fixed piston | 19/17/14 | 10 | 18/16/13 | 5 | 17/15/12 | 3 |
| Variable vane | 18/16/13 | 5 | 17/15/12 | 3 | - | - |
| Variable piston | 18/16/13 | 5 | 17/15/12 | 3 | 16/14/11 | 3 |
| Valves | | | | | | |
| Check valve | 20/18/15 | 20 | 20/18/15 | 20 | 19/17/14 | 10 |
| Directional (solenoid) | 20/18/15 | 20 | 19/17/14 | 10 | 18/16/13 | 5 |
| Standard flow control | 20/18/15 | 20 | 19/17/14 | 10 | 18/16/13 | 5 |
| Cartridge valve | 19/17/14 | 10 | 18/16/13 | 5 | 17/15/12 | 3 |
| Proportional valve | 17/15/12 | 3 | 17/15/12 | 3 | 16/14/11 | 3 |
| Servo valves | 16/14/11 | 3 | 16/14/11 | 3 | 15/13/10 | 3 |
| Actuators | | | | | | |
| Cylinder, vane and gear motors | 20/18/15 | 20 | 19/17/14 | 10 | 18/16/13 | 5 |
| Piston and swash plate motors | 19/17/14 | 10 | 18/16/13 | 5 | 17/15/12 | 3 |
| Hydrostatic drives | 16/15/12 | 3 | 16/14/11 | 3 | 15/13/10 | 3 |

*Table 4. Working fluid Hydraulic oil - CAT HYDRAULIC OIL (HYDO) SAE 10W*

| Label | Value |
|---|---|
| Relative density (on 15°C): | 0.878 |
| Flash point [method]: | >200°C(392F) [ ASTM D-92] |
| Limits of inflammation (approximately volume% in air): | LEL: 0.9 UEL: 7.0 |
| Boiling point: | > 316C (600F) |
| Density of steam (air = 1): | > 2 at 101 $10^3$ [Pa] |
| Vapor pressure: | < 0.013 $10^3$ [Pa] (0.1 mm Hg) on 20°C |
| pH: | N/A |
| Viscosity: | 37.7 cSt (37.7 mm2/s) on 40°C<br>6.1 cSt (6.1 mm2/s) on 100°C |

The results obtained in the test are shown in Table 5, whereby the hydraulic oil analysis has determined the higher working fluid contamination, i.e. the greater the number of solid particles than the standards has prescribed.

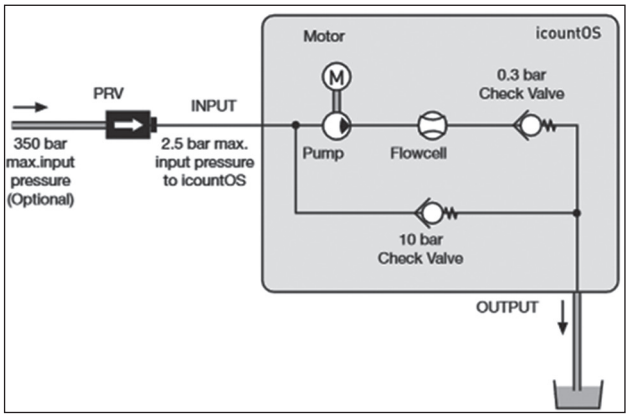


*Figure 5. Hydraulic system of oil tester (Parker icountOS - oil sampler) [7]*

*Table 5. Testing results for working fluid -hydraulic oil*

| Sample | 3500 h (Usage time) | 1850 h (Usage time) | New oil |
|---|---|---|---|
| 1 | 21/20/16 | 20/22/21 | 21/20/19 |
| 2 | 21/22/17 | 21/22/21 | 22/20/17 |
| 3 | 22/20/16 | 20/21/21 | 20/18/16 |
| 4 | */20/17 | 20/22/21 | 21/18/17 |
| 5 | 21/20/16 | 20/22/20 | 22/18/19 |

*Note: * The value could not be read*

For samples taken at 3500 operating hours of use, these deviations are significant, and a large number of particles are caused by internal damage of individual components of the hydraulic system. Also, it is possible to notice that the samples of the new hydraulic oil also contain a larger number of particles and some dirt. This is fueled by a typical hydraulic oil production process, which involves mixing, transporting, storing and delivering. However, by passing the hydraulic oil through the filters, the number of solid particles will be significantly reduced and closer to the prescribed values.

## 7. Conclusion

Whether it is a hydraulic system for power transmission or lubrication systems, oil purity is a prerequisite for proper operation of the system. Inadequate maintenance of hydraulic systems results in a continuously high cost of working process. In addition to regular monitoring of the level of contamination and the installation of suitable filters, it is possible to control the level of pollution of the working medium. This is why it is possible to extend the life of the hydraulic oil at least 4 times, which combined with a significant reduction in failures and extended lifetime of components, has far-reaching effects on the productivity and cost-effectiveness of the system. In addition to the benefits to the systems, maintenance of the oil also reduces the need for its change, thus reducing the amount of waste oil, thus positively affecting the environment and the preservation of natural resources.

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# Several issues related to present-day teaching process of physics in technical universities and enhancement of creative abilities and personal aptitudes

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**Abstract**

Teaching and learning process in higher education institutions are characterized by significant contradictory factors, especially the degrading interest in STEM disciplines. At present, performance, thinking pattern accuracy and methods engineering, applicable within the domain of both theoretical and practical activities, are exclusively high requirements for engineering-technical personnel. There is no doubt that science subjects (including physics) should be studied at a high competent level encouraging successful development of student professional stability. This paper discusses the major issues in today's teaching process in technical universities and how to enhance creative abilities and personal aptitudes of students (i.e. future engineers) through self-directed learning, on the example of physics which is one of the basic subject for any engineer.

**Key words:** STEM, self-directed learning, creative abilities, personal aptitudes, physics.

## 1. Introduction

Nowadays, the teaching and learning process in higher education institutions (i.e. universities) are characterized by a number of contradictory factors: on the one hand, sustained content knowledge growth concerning this or that specific discipline opposed to course duration of the course; and on the other hand, the increasing total number of students comparable to the individualization tendency of the learning process itself [1].

It should be noted that another contradictory factor could be considered the degrading interest in STEM (science, technology, engineering and mathematics) disciplines, including physics. In numerous countries the percentage of young people choosing this or that engineering profession is decreasing. This situation exists in Russia and is partially associated with the decline in the industrial output.

Universities should provide maximal eligibility of graduate knowledge-driven with specific skills to present-day production demands and requirements. Psychologically, this relationship is associated with the growing role of intellectual elements within the framework of student class assignments and further in the professional engineer experience. To process the enormous amount of information, an engineer should not only master a definite but also knowledge-based system [2].

The acute problem of selecting that information which would be more useful for a future engineer is becoming quite obvious. This information should be selected systematically relevant to the demands and requirements of technological advances. Another challenging issue is to improve the education process effectiveness itself [3], [4].

Academic knowledge systematism and engineering skills and abilities should be developed from the very first days in the university. The system approach improves the positioning and memorization of academic knowledge. This makes it possible to master a significant amount of information within a tight time limit, which, in its turn, becomes the foundation of follow-up engineering activities [5].

## 2. Theoretical Overview

At present, performance, thinking pattern accuracy and methods engineering, applicable within the domain of both theoretical and practical activi-

ties, are exclusively high requirements for engineering-technical personnel.

In this case, student knowledge systematism management in the teaching and learning process should be based on main memory image as the optimal means of knowledge storage and its further accumulation. Unfortunately, there is a lack of fundamental research concerning the above-mentioned problem.

As the study term can not be prolonged and a modern engineer should master strong fundamental knowledge to solve up-dated technological, technical and academic problems, it is necessary to concentrate more on fundamental sciences in universities.

Developing the research approach in engineering problem-solving, the physics content -material should be presented as fundamental concepts whereas mathematical induction is based on these concepts and result in the identification of practical pattern series. Besides, physics content-material is presented as "common idea" notions, i.e. any question under discussion involves a base leading the link of this idea (notion). Occasionally, a more insightful notion is the basis for a series of questions.

There is no doubt that science subjects (including physics) should be studied at a high competent mathematics level, otherwise the teaching process itself would be a simple more detailed narration of the school curriculum. So, learning physics is impractical in the first year when the students do not know the basis of higher mathematics, differential and integral calculation and he / she is not ready to learn vector and tenor analysis.

The major elements of effective learning is student mobility, their learning proficiency, commitment and orientation to learning. It should be highlighted that the teacher's task is not to control and evaluate the existing student knowledge, but to teach the students, i.e. to enhance both their theoretical and practical knowledge. L.S. Vigotsky [6] underlined the fact that the education content, its system and concept structure are the main factors in developing the cognitive knowledge structure. Although the learning process management is implemented through different methods and techniques, the most important factor is the optimal selection of learning material and its specific introduction sequence. It is assumed that the selected learning material and its organization would provide those conditions for a student not only to master the subject course but also to enhance harmonious individual development and intellectual competence. Obviously, the selected and organized learning material predetermine unambiguously the student achievement level and soft competencies. However, they are the foundation which could optimize the learning process.

With regard to justification of and scientific background, teaching is not a subject of research target, but only a subject of construction. Scientifically, not learning activities but project-based learning itself embraces a combination of materials, including the instructions for teamwork between teacher and student. V. I. Zagvyazinsky [7] identifies three basic learning elements: content-material (syllabus), teaching and learning and, consequently, supposed analysis of teaching and learning process at the level of functional relations between these elements. S.I. Arkhangelsky [8] the main learning process elements as: content-material (syllabus); teaching methods and techniques; learning modes and techniques; student class assignments; and teacher functions.

Despite the above-mentioned definitions of the concept "content-material (syllabus)," it should be stated that (1) the interpretation of this term describes the dialectical unity of both the learning process and content-material (syllabus); and (2) there is still no accepted interpretation of this discussed concept.

In terms of physics theory alternation, it is necessary to emphasize the fact that when an experimental idea originates (fundamental notion), new notions are developed based on this idea and a theory is put forth via deductive method to be experimentally justified. However, new emerging experiments are contradictory to this theory and again a new paradoxical idea appears whereas one more theory is based on this and the sequence is repeating. In this case, the old theory is an exception to the new theory within limited application domain.

### 3. Psychological aspects in developing student self-directed learning

An essential condition of creative thinking development is the implementation of mental activity in learning. Mental activity should penetrate into

all those aspects involved in the learning process. The subject content is rather important in developing the student creative abilities. The teaching and learning process should be organized so as talented students could develop their skills and abilities, i.e. the teaching and learning process should be differentiated to foster student individual performance. In such a case, greater focus should be placed on the creativity potential of a student. The students should have the opportunity to participate in research project. Research teams should have material resources for research projects. The problem of student research projects is includes as an aspect in a broader perspective of this problem.

Traditionally, the problem of personality orientation and its self-comprehension is the subject of psycho-pedagogic analysis. However, orientation is a more focused problem in numerous researches. The research, conducted by I. Bozhovich, revealed the fact that personality stability embraces such a personal complex as personality orientation and its self-evaluation. In [8] this concept has a broader meaning and includes not only self-evaluation but also self-comprehension in general (awareness of personal experiences and their self-evaluation).

Globally, orientation could be considered with the respect to what a person gets and takes from the society (i.e. material and spiritual values), which, in its turn, contributes to the development of the person himself / herself. However, this becomes evident when psychological attributes and personal states are being studied as a system: needs, interests, aptitudes, motivating sphere, material orientation, abilities, character, willing, emotional and intelligent characteristics, etc.

Orientation is not inborn, it is developed throughout the upbringing. Of course, this does not mean that an individual is only an object of educational actions. He / she is the subject for whom definite external social behavior becomes internal ones. As a personality is unique and one-of-a-kind this influence should be also individual. The main point of the individual approach is that the personality characteristics should be considered when choosing the optimal aims in his/ her development, including relevant pedagogical actions.

Professional stability is integrated education as a total of all professional personality development. Professional stability is considered as the positive motivated attitude of a student to his / her chosen profession, which, in its turn, is focused on the fulfilling one's life goals through this or that professional activity.

Perennial research, discussed in [5], described the following pedagogical conditions encouraging successful development of student professional stability:

1. high professional level of university staff, especially teachers of profile departments; optimal organization mode of studies and pedagogical work and on-the-job training, providing the possible student- highly-qualified teacher- specialist interaction;
2. organization of student self-actualization and professional self-improvement from the very first course; establishment of psycho-pedagogical units in universities;
3. from the first course, student involvement in modern research methods.

Personality, competency, dedication and pedagogical skills of a teacher greatly influence the student professional stability development. Elaborate professional training, sensible to the student individuality, should become the capstone of shaping student personal fulfillment, i.e. motivation.

Personality, competency, dedication and pedagogical skills of a teacher greatly influence the student professional stability development. Elaborate professional training, sensible to the student individuality, should become the capstone of shaping student personal fulfillment, i.e. motivation. Social-psychological and functional commitment of a student to research is claimed to be coherent personality characteristics.

This commitment involves definite personality integration: developed value-based orientation, motivation and strong-willed personality. Special commitment embraces motivation of activity and its influence on the development of research competencies.

In most cases, motivation of research activity is the result of the previous personality development and is the subjective reaction on external actions stimulating the motives. Influence of motives on developing research skills is reflected in the dependency between external and internal stimuli and activity motives. For example, the demand for

enrichment experiences of a student is an internal motive which significantly influences skill shaping; while the endeavor to get a positive mark is the external motive which activates the development of skills only at a certain stage [9].

## 4. Aspects in student self-directed learning

Modern teaching in universities, especially in physics, should foster an interest in presented content-material and generate a creative approach to its learning and practical application. More recently, the creation aspect has become challenging within the framework of natural-science analysis. Economic progress is closely associated with such concepts as talent and creative capability. Fundamental science progress depends not only on the number of scientists but also on top-level talent. Fundamentally scientific ideas could be in the head of one scientist but is not the foetus of a group endeavor. A scientist does not coordinate the work of numerous people, but co-opts the intellectual influence and needs of the epoch and, based on this, develops the fundamental ideas. Thus, to develop science the so-called "genius brains" are essential. A genius- this not simply talent, creativity or eminent achievement. This is a person who displays exceptional intellectual ability and is associated with the achievement of new advances in a domain of knowledge. All breakthroughs and achievements have past roots and so are intertwined with the present, i.e. why they become renowned. Culture (in the broadest term) influences the development of creative potential as every culture has its own value system and demands which could informally influence the people. Besides, there are favorable and retarding factors for the development of creative potential. Recently, the problem of creativity passes into another category and now it has become acute for natural science analysis. In consequence, it is important to reveal creative individuals. In this case, to develop the creative abilities in physics it is necessary to understand the specific features in the creativity development within this or that science. Science development in physics is associated with the changing and reinterpretation of physics notions.

The teaching and learning process in a university proceeds from student individual work. This is one of the major tools in advancing university education and enhancing specialist training, i.e. to enrich one's knowledge base being oriented on the research information flow. The university should foster the drive for constant refreshing knowledge of future specialist.

One of the basic tasks in enhancing the education level in universities is working on and organizing effective student self-directed learning. Thus, the most essential factor in determining effective academic study is its planning. Academic course programs should be designed with due consideration of independent instructional course-material, which, in its turn, is a logically completed review within the topic summary itself. The program plan should involve the assignment content and volume for self-directed learning, as well as required time thresholds.

Self-directed learning task in higher education school includes optimal organization and systematic time management. Effective teaching and learning process is determined by its performance outcome, i.e. academic and practical training level of the students. Thus, thorough understanding of proper learning outcomes is the most important factor embracing the whole teaching and learning process in a university. Understanding the sound learning outcomes makes it possible to identify the weaknesses and strengths when organizing the curriculum-education process and, consequently, eliminating and initiating measures of the arising shortcomings. Management of student self-directed learning process does not exclude the further development, monitoring and adjustment of this process [5]. Prompt analysis of student self-directed learning process and the system of its improvement is necessary throughout the term.

Well-targeted monitoring system of student self-directed learning is the cornerstone of its organization, which, in its turn, promotes student educational drive, facilitates student skills development of study performance management and initiates those student qualities for his/her further learning progress.

Problem-based learning fosters the development of student independence in the rationalization of different physical phenomena, obtaining in-depth basic theoretical knowledge to explain this or that phenomenon. Problem-based situation is created through a transparent educational prob-

lem statement, the content of which enhances the student. The principles of a problem-based situation is defined by the specific course content itself. Creating a problem-based situation could be based on the following: (1) emphasizing the practical importance of the topic under study in order to solve the most pressing problems in physics; (2) advancing disputed hypotheses; (3) stating research problem and (4) developing formula and etc. In general, any solution of an entangled task in physics could be the resolution of the problem-based situation if the student has solved this or that task independently, but not written off the class board.

Practicals in some universities include elements of problem-based learning: at the end of every class the next topic is stated and study case problem for individual work. The students independently study the required theoretical material and solve after-problems. At the beginning the home assignment is analyzed. Later more complex problems in this topic are solved. This can be only in groups with high – level school background knowledge in physics. It should be noted that this methodology (when the topic is not elaborated in class) is impossible to include more complex tasks, more interesting in terms of physics.

Although student performance is enhanced through practicals, it should be based on acquired theoretical knowledge and innovative thinking. The following factors significantly influence the student performance in problem-solving:1) problem content analysis, problem-solving methods and decision procedure and results; 2) statement of attribute-based questions and tasks; 3) problems with missing data (problematic tasks); 4) different solution methods for one and the same task. In-class learning exclude the possible resolution of knowledge information processing. Creative teaching information processing is possible only on the basis of systematic and well-organized learning of physics which can be achieved through intensive self-directed learning.

Laboratory practicals (practicum) in physics provide in-depth acquisition of the basic physical laws and phenomena. Laboratory practicals (practicum) assume utmost significance in view of cultivating experiments which involve the application of advanced technology and precision measurement instruments. The task of lab practicum is to instruct the student in applying the technology and to cultivate the necessary skills in performing experiments. The literal translation of "laboratory practical (practicum)" is activities emphasizing the practical application of theory (i.e. theory is put into practice). Thus, accordingly, performing the experiments in laboratory conditions should be followed by resolving selected problem-based situations. For example, reasoning accuracy of model selection to examine the studied phenomenon, theoretical conclusion to calculate the formula and reasoning errors of measured values. Practicum in physics is more effective as it is possible to study more precisely the physical phenomena and their interactions while lectures exclude this possibility.

Systematic learning progress, being considered an integrated part of academic teaching and learning activities, requires everyday student performance throughout short-term period, This is one basic factor in the personality formation of future creatively forward-thinking specialists within the higher school environment. However, it should be stated that not all students exercise the advantages which self-directed learning involves. It is not uncommon that the majority of students ineffectively work on the consolidation of the course-lecture material, and, quite often, advance this over for another time, i.e. before forthcoming tests and term exams. These students, which are usually called "lower-achieving" students having a command of elementary skills in organizing their mental performance but exhibit sufficient competencies for solid academic activities. Such students are neither accustomed to accurate note-taking nor understanding the pressing need to analyze and consolidate the course material.

Nowadays, a standard monitoring system of theoretical knowledge acquisition and achievement of student practical skills exists. Coupled with the traditional existing monitoring methods and forms, programmed control approach, thematic modulus test and others are applied. Numerous educational programs in physics involve both the informative and testing function. A series of attainment level are set out to monitor the course content acquisition. Monitoring results could be intended to achieve learning process management. After-monitoring information depends on the learners' responses.

Experience has proven that reliable periodic assessment of student learning achievement in a specific time interval throughout the term could be considered as competent assessment of examination session results. However, it should be recognized that quite frequently there are cases of inconsistency between monitoring and (final) assessment and examination results and test examinations.

As evidence shows formative assessment should be based on creative exercising of traditionally existing student knowledge assessment methods combined with up-dated approaches and methods of programmed control and evaluation of course content achievement. It is important that academic achievement is an integrated part of the learning process which promotes the student's development and shaping not mechanical and stereotyped skills but creative skills for systematic learning activities. Knowledge assessment-one of the basic modes of the learning process itself and it should be relevant to the modern development conditions and targets concurring in the higher education system [9].

Both traditionally classic methodology (lectures, laboratory classes, practical involving the analysis and solution of different problems, seminar classes, etc) and sophisticated computer-aided methods. Teaching proficiency in physics includes such material presentation (curriculum models) via successive logical actions and reasonable compiled experiments that would formulate basic physical concepts, provide insight into basic physical laws and theories.

To develop the research approach in engineering problem-solving, the material in physics should embrace detailed fundamental concepts, being the principles of either a mathematical model or theory, which, in its turn, would result in determining actual governing laws. Regardless of what teaching method or approach is used, the main factor is fostering research interest in physics through new and new program material. It is essential to evaluate the possible and practical application of this or that method.

Working on individual projects involving the design of different physical devices promotes the development of creativity skills. However, when performing creative activities the students have difficulties in time management which involves both acquisition of physics course material and project classes. In this case, creative projects should not be the predominate factor in first-year studies. Complex projects hinder the in-depth coping of the curriculum in physics, as the project itself is time-consuming. There is the so-called "collision" between the development of creative skills and effective time management. It is not uncommon that students developing a complex project encounter significant gaps in the knowledge of basic physics laws [2]. In view of this fact, complex projects should be either performed in student team groups or "rejected" (especially, those projects which involve specific problems).

## 6. Computer- an essential tool in self-directed learning

Present-day teaching in universities is defined by the significant amount of information which should be successfully mastered within a relative short time period. Increasing flow of scientific-engineering information requires increasing number of hours for this or that discipline, as well as more effective time management in planning practicals and lab classes.

Creatively fast thinking and competent specialists are of great demand in our contemporary society. But the question arises- how to train such a competent engineer who would possess relevant knowledge and the capability to solve problems creatively. Most teachers consider that problem-solving should involve not knowledge overview of all sciences, but student interest for autonomous creative work which would develop his/her capability in further self-directed learning.

A significant aspect in learning physics could be considered the process of developing skills in operating information. Developing skills in plotting an information model is related to common skills. Generalized methods, general methodological principles, limited concepts, etc. could be applied systematically and explicitly in the teaching and learning process to sequence the flow of information that student have to acquire and cope with. Essential elements of information should be arranged on an absolutely new conceptual basis, i.e. computer-based. In this case, PC could be applied

not only for calculations and data processing, a required skill for future engineers, but also be integrated into the teaching and learning process of physics itself. All routine and repetitive work that student has to do can be replaced simply by the computer (i.e. calculations, recording and storing information, experiment data processing, plotting graphics). Thus, the learning process becomes less time-consuming and demanding and a student can focus on his/her attention on understanding the core essence of this or that phenomena.

Computer-based learning could resolve the problem of differential teaching. As computer-based learning fosters individual student learning, the teacher has the possibility to effectively interact with students of different knowledge-levels. In view of this fact, special programs and methodology should be developed and introduced into the teaching system itself. The appropriately selected program would enhance the progress of every student according to his/her potential and capability.

The advantages of such computer-based programs would be: (1) effective interaction between teacher and student; (2) enhanced performance level of students in practicals and laboratory classes; (3) involving students in self-directed learning and (4) integrity and efficiency of this teaching method. However, this method should not be overemphasized or overrated. There is one significant disadvantage that should be considered- only sound computer-based program would be highly-effective in the teaching process. Nevertheless, software support involves a rigid scenario based software architecture, which, in its turn, excludes the evaluation of original task solutions [9].

Technology development and up-dated teaching programs (curriculum) results in the possible improvement and upgrading of the teaching and learning process. Of course, in this case, students become more and more dependent on computers in problem-solving and information processing. However, it should be noted that the computer is ONLY a tool to solve this or that task, but not a "substitute." It should not become "a goal in and of itself", especially in higher education institutions. With due diligence, computerization should be integrated into the teaching process and be a part of selected software applications and determined optimal class hours.

For example, in physics practicals the students are prohibited to use Internet to find the basic physical laws and formula. The reason is very simple- due to the lack of time, the student does not obtain further insight into the description of the phenomenon and accompanied formula, and, in most cases, dimly understands the physical meaning. Students only imbibe knowledge background from Internet, only write down the formula without understanding its essence and meaning. Students are only "robots" copying information and task solution without thinking. While those students who investigate and analyze textbook material have more in-depth knowledge.

## 7. Conclusion

Present-day teaching in university should enhance student interest to presented materials in physics and motivation for self-directed learning and further practical application. To develop a proficient teaching program being relevant to those arising questions within the framework of self-directed learning is rather challenging. It is the teacher who is the initiator in these problem-solving situations. Although the computer could be effective in expanding and advancing student knowledge in physics, it can not be applicable in all the cases. Face-to- face communication (teacher-student) involves not only monitoring but also teaching elements, and, in this case, it should be the determining factor in lectures, practicals and laboratory classes.

The commitment for continuous knowledge upgrading should be fostered by the university. This is one of the basic means for university education enhancement, quality improvement of specialist training, i.e. knowledge enrichment and orientation in the scientific knowledge flow. The aim of a physics teacher in a university should result in teamwork (teacher- student), where the latter learns physic phenomena and how to apply this knowledge in his/her future professional life [10], [11], [12].

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# Enhancement of dissaster understanding through dissaster learning media of PGSD students in Peradaban University academic year 2017/2018

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**Abstract**

The aims of this research are: 1) improving Disaster Learning Media of social science education subject, chapter disaster of primary teacher education students at peradaban university 2017/2018; 2) Expanding disaster material of social science education on primary teacher education study program of Peradaban University; 3) understanding improvement of social science education subject of primary teacher education students at peradaban university. This research use *Research and Development (R & D),* and also stages of instructional development which covered Penelitian ini menggunakan tahapan pengembangan instruksional, meliputi fase *analysis* (analisis), *planning* (perencanaan), *design* (perancangan), *development* (pengembangan), *implementation* (implementasi), *evaluation* and revision (evaluasi dan revisi). Result of this research shows that; 1) enhancement of disaster teaching and learning material is in proper category and can be used, by average counted per aspect: 78,9; 2) Validation result of RPS (Semester Learning Plan ) disaster enhancement also in proper category by average counted per aspect: 80,21; 3) Result of *pre* and *post*est of this research has significant value that R *Square* is 0,821=82,1%, it means that enhancement of disaster teaching and learning is proven that it can increase disaster understanding of social science material in Elementary Teacher education Programs (PGSD) at Peradaban university. Their understanding of landslide disaster in Brebes district is caused by high intensity rainfall and the worst condition of upstream in Salem sub-district, Brebes. While for the floods is caused by the broken dyke of Pamali river. Their understanding of readiness in facing disaster is increased for about 89%.

**Key words:** *Enhancement, teaching and Learning Media, Disaster, Social Science Education, Elementary Teacher Education Programs (PGSD)*

## 1. Introduction

Education is a process of forming a whole person; it means that there is a mutual activity and constituent series to succeed human journey to be a smart, intellectual and social person series. It corresponds to the goal of Indonesia establishment; participate in educating nation's life. This is not individual or social intelligence, but it covers national life intelligence, it understood as a general condition that experienced by citizens, such as economic, social and culture condition [1]. Achievement effort in education on University level, government has made efforts to increase education quality, in example revitalizing curriculum on highest education (University) level to the Framework National Indonesia Qualification (KKNI), it included KKNI for S1 degree graduate of Primary Teacher Education on level 6, they are hoped to have ability in mastering theoretical concept of certain knowledge and skills in general and specifically the theoretical concept of skills and knowledge deeply in primary education, because a good teacher must create a good teaching and learning material [2]. This corresponds to Nelitawati's statement that the teacher must have academic and pedagogical competence in order able understanding students [3].

The main competency that must be have by S1 degree students of Primary Teacher Education pro-

gram, Peradaban University, they are: 1) Applying knowledge, technology, and/or art in their science through teaching and learning activity in primary school; 2) Developing teaching and learning process in elementary school which helpful for education; 3) Problem solving of Teaching and Learning based on research that helpful to increase teaching and learning quality; 4) Responsible to the task of elementary school educator. In achieving main competence in Primary Teacher Education program, so there is a course of Social Science Education [4] which consist of basic philosophy of Social Science Education, theory, goal, function and scope of Social Science Education, Teaching and Learning Social Science Media in Elementary School, material of Social Science education in elementary school, analyzing the content of the Social Science education of elementary school, approach in Social Science education, the model of teaching, learning and evaluation of Social Science teaching and learning in elementary school, preparing of Teaching and Learning of Social Science in elementary school, and disaster Education. Disaster Education has been campaigned by Hyogo Framework for Action as part of priority 3, focusing on the *"use [of] knowledge, innovation and education to build a culture of safety and resilience at all levels"* (UNISDR 2005). More recently, the 2006-7 UNISDR campaign "Disaster risk reduction begins at school" aimed to promote the integration of disaster risk reduction into government plans for school curricula and to ensure that school buildings are safe from the impacts of natural hazards (UNISDR 2006, Wisner 2006) [5].

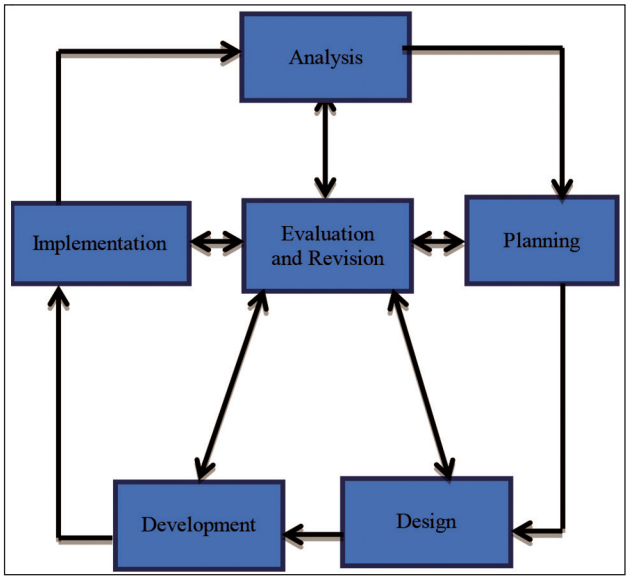
The importance of disaster education material on Scholar, because people around the world know that Indonesia is located on 3 plates they are; Indo-Australia, Pacific, and Eurasia plate which caused that Indonesia has high potential disaster. Because of this potential, it is hoped that Indonesian aware about disaster. The process of plate dynamic that quite intensive creates typical of earth relief surface and has very variety in form of mountain area with steep cliff that implies high potential landslide to the sloping area along the beach that potentially floods, land subsidence and tsunami [6]. In addition flood and tsunami thread, Indonesia also has many volcanoes which spread from the west to the east that known as *Ring of Fire* [7]. Landslide and floods is an annual disaster in Indonesia, these disasters threaten Indonesian survival [8], because of the intensity and disaster spreading that almost surge in Indonesia. By this potential Indonesian are hoped aware of disaster. Awareness of it can be reach through education; this corresponds to the research of Leleito [9]. So because of the high disaster potential, need awareness of the society. At the need level government must explore the disaster hazard, know how to overcome it and the frame work [10]. In spite of government role, University roles are needed to serve disaster education to the Students in order to have complete knowledge of disaster. University becomes a most important part of citizens' awareness about disaster. So they always ready to face disaster. Ohnishi told that *"Some elements of disaster prevention education were added to the new curriculum on Social Studies and geography. Disaster education's role becomes much more important for saving children's lives"* it means that the other element of preventive action related to disaster is implicating disaster education to the social science and geography curriculum, disaster education is a new important role to save students life from disaster [11] [12] [13]. So disaster education is university's responsible, in this context it must apply disaster education to the curriculum of Geography and Social Science, this statement is supported by Wang [14], deliver his result research that; school more implemented approach and manage integrated disaster risk, readiness in organizing comprehensively of environmental readiness practices, software planning, disaster simulation of injuries, death, property damage, can be reduced effectively and schools' resilience of disaster can be improved successfully. Social science education has important role in preparing students in their daily life, Irem and Mehmet did a research about social science in German, America and Japan, and the result research of it *"Teaching activities that resemble real life experiences from these countries by presenting photos and/or other visuals and discuss how it is possible to get student involved in these nonfictional activities"* it means that the teaching activity of Social Science more emphasize to the practice in real life, then they present picture and the other visual object, then discussed it, students involve directly

in teaching and learning activity [15], in teaching and learning activity emphasize the social values, this suitable with delivered by Alimcam and Altunay *"Importance of values which is a building stone of individuals' character, the effect of media on values and how it affects people's behavior and what can be done to decrease negative effect was dealt with"* which means that the importance of social value which is a learners foundation to be a characterized human, the effect of media and social value, of how they reduce their negative behavior [16]. Social value role is very important to help them in interacting with society because social value is very important in overcoming disaster in Indonesia, so it needed to integrate material and curriculum of disaster included in University material. And the prevail curriculum must be able to prepare students in their daily life, through implementation of direct social science learning/ practice in real disaster phenomenon by taking picture the development of the recent community, in order they can be an active citizenship, and have ability of good disaster responsiveness [17]. Based on the test result of social science material on 4th Semester academic year 2017, cognitively got A score from a total students as big as 2% and the B score; 44% while C score; 54% (Final Test score of Primary Teacher Education 2017) and in disaster education material students are still face difficulties, so it needed to develop disaster education device which is hoped can increase the understanding of disaster. Based on the background so it is held a research entitled *"Developing disaster learning device to increase disaster understanding of Social science education scholar of Elementary Teacher Education, Peradaban University 2017/2018*".

## 2. Research Method

The method of this research is *Research and Development* it means that the method of this research is used to produce certain product. And test the product effectiveness of the product [18]. Research and Development research that well known R and D is a research that produce a certain product that is used in research that characteristically the need analysis and test the product effectiveness, so it can be functioned in wide community [19] this research developed disaster learning media at social science education, and the development is on Semester Learning Plan (RPS), the disaster learning material is completed with the answer. Result of social science development learning covered three criteria: a) Knowledge and Definition/ Cognitive; b) Skill and Habit/ Skill; c) Purpose and Attitude/ Affective. Based on the explanation above, so the result of the disaster learning developing is to prepare the student of elementary teacher education program (PGSD) to have good understanding of disaster.

Subject of this research are the 4th semester students of elementary teacher education program (PGSD) academic year 2017/2018 at Peradaban University. This study uses research stages and development of disaster learning media. According to Fenrich [20] stated that development of disaster learning pointed to the *development cycle*. The instructional development of cycle covers *analysis*, *planning, design, development, implementation, evaluation and revision* phase. Revision and evaluation phase is a phase that is done in every phase along the development of disaster learning media cycle.




*Picture 1. Model of The Instructional Development Cycle*
*Source: (Fenrich, 1997: 56)*

Analysis phase of this research are; 1) disaster potential identification in Brebes district; 2) analyzing achievements of students learning outcomes; 3) creating disaster curriculum of social science material at elementary teacher education (PGSD); 4) achievement indicator identification.

The arrangement phase of this research are; 1) arrangement of disaster learning media in the form of RPS and disaster material; 2) arranging the test of learning outcomes; 3) validate learning media; 4) revision and evaluation

Development phase of this research is done after arrangement phase that has been applied by testing the disaster learning media to do analyzing and revising, so produce the final device. Designs of the research are *one group pre test dan post test design.* Result study before treatment (*pretest) and after treatment (posttest)* by picture of research design of *one group pre-test-post-test)* is shown on picture 2.

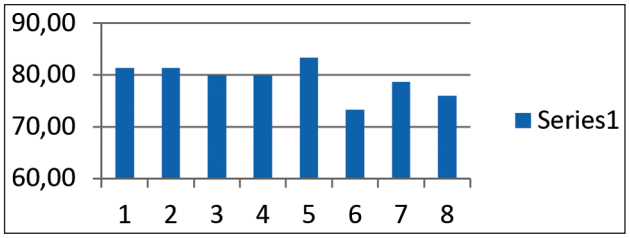
**O1 X O2**

*Picture 2. Research design of One Group Pretest-Post test*

Research variables cover three: 1) free variable and 2) controlled variable; and 3) bounded variable. Free variable of this research is disaster learning media of social science material that is used by students of elementary teacher education. Controlled variable of this research is disaster learning media material, trial test and learning time allocation. Bound variable here is the students' cognitive understanding of disaster material on social science subject. Data collection of this research are: 1) Validation; 2) and 2) tes. Instrument of this research is a tool to collect research data which is needed to answer researchers' question. Instrument of this research are: 1) validation instrument of learning media; 2) instrument test of study result. Learning media in the form of RPS disaster learning media of social science material must be validated before used in the research. Validate of disaster learning media are the 15 teachers of social science. Before used in *pre* and *posttest,* the question of the test must be tested to know about the appropriateness of the question to be used. The result of understanding learning (cognitive) is got by doing posttest.

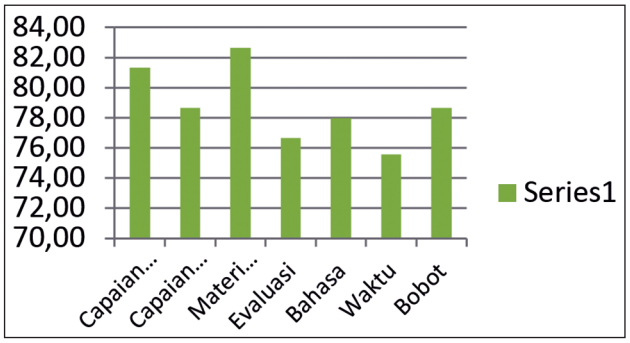
### 3. Result and discussion

Validate of this research covers disaster learning tool/ media validation, learning material validation, and the question validation by social science lecturer in Brebes district. The result of disaster learning RPS validation which has been validated by social science lecturers got average total score aspect 78,9 and appropriate stated to be used in disaster learning of social science material, below is the validation acquisition of disaster learning media, and the percentage score average per aspect in picture 3. For material validation got average percentage 80,21 can be seen on picture 4




*Picture 3. Gaining the aspect of average percentage score*

*Source: Validation result of 2018 disaster learning RPS.*




*Picture 4. Acquisition of average score percentage per aspect*

*Source: Result of material validation of disaster learning material 2018*

Table 1 shows that counting scheme of teaching and learning media and the validation of learning material.

After the learning disaster material and RPS stated appropriate by the validator, so the disaster learning media ready to use. Then the question item of *pre* and *post* is examined by *Kolmogorov-Smirnov* and counted by using SPSS, to know the distribution population is normal or not, is shown in Table 2.

At table 2, Shows that pretest score 0,703, and significant posttest 0.717. Because the significance of 2 samples is ≥ 0.05, so H1 is received. Shows that significant score of pretest is 0,703 and the significant score of posttest is 0.717. Since the significant of both sample ≥ 0.05 so H1 is received. It can be concluded that the 2 samples have normal

*Table 1. Counting result of scheme validity instrument*

| NO | Research Instrument | Result Rating (%) | Criteria Validity | Information |
|---|---|---|---|---|
| 1 | disaster Learning RPS | 78,9 | Appropriate | Can be used |
| 2 | Material disaster learning | 80,21 | Appropriate | Can be used |
| Average | | 79,55 | Appropriate | Appropriate can be used |

*Table 2. Normality test of Pre and posttest*

| One-Sample Kolmogorov-Smirnov Test | | | |
|---|---|---|---|
| N | | Pretest | Postest |
| | | 31 | 31 |
| Normal Parameters[a] | Mean | 66.58 | 73.19 |
| | Std. Deviation | 10.363 | 9.050 |
| Most Extreme Differences | Absolute | .126 | .129 |
| | Positive | .126 | .090 |
| | Negative | -.087 | -.129 |
| Kolmogorov-Smirnov Z | | .703 | .717 |
| Asymp. Sig. (2-tailed) | | .707 | .682 |

*a. Test distribution is Normal.*
*b. Calculated From Data*

*Table 3. Output Anova Regresi X to Y ANOVA[b]*

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2645.690 | 1 | 2645.690 | 133.236 | .000[a] |
| | Residual | 575.859 | 29 | 19.857 | | |
| | Total | 3221.548 | 30 | | | |

*a. Predictors: (Constant), disaster understanding of social science material Y.*
*b. Dependent Variable:Disaster Learning Media X*

*Table 4. Output Coefficient persamaan regresi X to Y*

| Coefficients[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -9.374 | 6.629 | | -1.414 | .168 |
| | Y | 1.038 | .090 | .906 | 11.543 | .000 |

*a. Dependent Variable:*
*b. Disaster Learning Media X*

distribution. The influence test result of disaster learning media to increase understanding of social science education material: The Hypothesis:

$H_0$ = (there is no linear influence of disaster learning media to increase the understanding of social science material).

$H_1$ = (there is linear influence of disaster learning media to increase understanding of social science material).

In this research calculation of the data is counted by using SPSS program. The result can be seen at table 3.

Table 3, above showed that The F Score =133.236 and the significant score 0.000= 0% <5%, so $H_0$ rejected. It means that there is linear influence significant of social science material. Regression coefficient can be seen at table (4)

From the table 4 above known that a score = -9.378, b= 1038 so it was got equality regression Y=-9.374+1.038 X. it means that every variable adding of disaster teaching and learning media as many as one unit, so it will increase the understanding value of social science material as much as 1.038 shown the positive regression coefficient, so disaster teaching and learning media react posi-

*Table 5. Output Model Summarry X to Y*

| Model Summary | | | | |
|---|---|---|---|---|
| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the Estimate** |
| 1 | .906[a] | .821 | .815 | 4.456 |

*a - Predictors: (Constant), Y*

tively to the understanding of social science disaster material. In this case, students understanding of natural disasters are floods and landslide, which is occurred in Brebes district. Their understanding of it, is caused by the high intensity of rainfall and the worst condition of upstream in Salem Sub-district, Brebes district. While for the floods is caused by the broken dyke of Pamali river. Their understanding of readiness in facing disaster is also increased for about 89%.

Their understanding of readiness covers instructional evacuation of pre warning media and the disaster guidance of landslide and floods.

This research result supports a research that is conducted by Setiawan, that there is significant effect by adding disaster curriculum to the teaching and learning activity, it also strengthen by Adiyoso's research that, the school that adopted disaster issue on the curriculum, it could enhance students' disaster understanding, and also enhance the students' readiness in facing disaster.

The influence can be seen on table 5.

From the table 5 above obtained that R *Square* 0.821 = 82.1%. That score shows that disaster learning media variable influence the understanding of disaster social science education material in the amount of 82.1% or there 17.9 is affected by other factors.

## Conclusion

Based on the result analysis and discussion can be concluded that; there is significant influence and enhancement about natural and non-natural disaster, many kinds of natural disaster and readiness how to overcome or face floods and landslide which is occurred in Brebes district in KKNI level at 6 stages. Then all colleges in Brebes district are recommended to integrate the disaster teaching and learning activity in social science material, because by applying it, which has proven that students' understanding about natural disaster and the mitigation especially floods and landslide which is occurred in Brebes District increased. Their understand athat they are able to of disaster learning media to the understanding of disaster social science material at elementary teacher education (PGSD) program of Peradaban University academic year 2017/2018, Their increased understanding of disaster, any kinds of disaster and preparedness of natural disaster in Brebes district. While for the Brebes people this research gives the new concept about the understanding of natural disaster through integrated disaster learning at the media of Semester Learning Plan.

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# Planning and organizing interactive learning in the classroom and learning mother language

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**Abstract**

Class teaching is very specific, and so does the work itself. Pupils of the younger school age require special attention and engagement. Teachers must and should be further educated and trained daily to improve the changes in the society to which they are exposed. They must constantly learn and be active participants in today's teaching organization. They have to plan and organize learning in a more interesting and acceptable way. Interactive learning enhances classroom work in all teaching subjects, especially in terms of language, mathematics, and nature, and society, but can also be applied to other subjects. Consequently, in our work we were based on the transformation of the traditional way of learning into learning by interaction. The goal of our research is to change the current way of learning in terms of teaching innovation through interactive learning and promotion, achieving better and more efficient results. We tied our tasks to the contents of improving teaching, improving teachers, applying interactive learning, achieving better results, attaining autonomy in student work, and so on. It is widely known that interaction provides children with optimal development, enhances communication and other child's abilities, as well as creative qualities. It is very important that the interaction is active and at the same time healthy.

**Key words:** interaction, interactive learning, classroom teaching, innovation, organization.

## 1. Introduction

Curricula and work programs in schools are pre-defined and defined. Usually, in time, several changes were made, but not enough. Only planning and organizing them should be updated on a daily basis. There is also a need for greater deviation from the prescribed rules, which teachers are not always able to. In terms of stimulations, it is necessary to organize a different classroom, a teaching that helps students in their progress in all fields of education. It is necessary to approach modern teaching tendencies. By introducing innovation, this can be achieved in a certain way. Interactive learning is facilitated by the teaching process itself, but also by other factors that influence the quality of teaching and teaching process. The organization of the interactive process in classroom teaching is a very complex and difficult job, and it must be cautiously and skillfully approached. We will identify some of the basic characteristics of interactive learning in classroom teaching and a series of specificities in the work that this teaching provides. Specifically, interaction in the future should be the key to the success of each teaching process.

## 2. Planning and organization of interactive teaching

This type of teaching needs to be planned for a certain period in order to organize it properly and perform it properly, and also evaluate it according to clear instructions. Teachers have to constantly search for a new way of learning and progress, that is, their desire for constant improvement and improvement is required. As in all the planning processes, as well as in the process of planning work in education, common divisions that include a criterion of time are common. It is widely known that the most commonly different planning names are distributed within two dimensions: strategic planning (over a period of more than one year) and operational planning that involves the definition of specific activities to be undertaken in achieving strategic goals for a period of one year, month, week or days, in our case, operational planning within a year, or by months in school organizations [1]. We know that operational planning most

often involves the development of special work plans in the school (professional development of teachers, improvement of educational work, partnership with the family, etc.) and plans for the direct work of teachers with students (global / annual, monthly, daily planning, time). The goal of strategic planning is to determine the vision of the school in terms of the desired long-term development in the context of the expected changes, in our case interactive learning and its planning. Despite this great importance, this kind of planning in school today is much neglected. The development of an annual school work program can not be classified into strategic planning, despite the great similarity in approach.

The curriculum for programming work at the school is the Curriculum and Program. The curriculum is a state document that prescribes educational contents that need to be taken at the appropriate level (level) of education, and the curriculum is a document that prescribes courses and hours / classes for individual educational subjects, or the curriculum is a school document that prescribes: scope, depth, order of teaching content. The curriculum prescribes the specific contents of a particular subject, so the curriculum is a concretization of the curriculum [2]. In connection with classical planning, teachers are obliged to plan interactive learning in order to perform it in an adequate way. At the beginning of the school year, a plan should be drawn up outlining the subjects for which interactive learning will take place, the number of hours to be realized, as well as the means and methods of work for which interactive learning will be applied, and also the planned expected outcomes achieved by this type of learning. All these guidelines should be compiled and contain a single form that would look like a global work plan.

In the example shown, the planned parts of the interactive learning curriculum would be entered in the order, similarly to the pre-defined curriculum plans. In our case, these types of plans would be exclusively a radio teacher for subjects that he considers to be doing interactive learning and content that can be done for this type of learning. Then, the plan would be made at the beginning of the year, which would be changed on a monthly basis according to the students' interests and abilities.

## 3. Interactive learning and classes of language

Interaction and interactive learning in school conditions are treated in the context of cooperative learning, learning in pairs, groups, and so on. During the cooperative work the teacher's role is changing. He ceases to be a lecturer and organizes his work in such a way as to determine the way in which students are divided into groups, envisages classroom work in the classroom, and ways of replacing places, if necessary during work, preparing pupils for work instructions and knowledge sources that will be used to solve their assigned tasks. The benefits of collaborative work are enormous. Students learn:

- „Together choose the strategy,
- Solve problems and plan;
- It is more interesting to study with others through activity;
- Each other establishes good cooperation;
- Independently think and express themselves;
- Excitement and curiosity return to learning;
- Alternative methods of learning are provided, and they learn better;
- Better learn the whole of the teaching subject;
- Confirm their values;

*Example 1. Interactive Learning Form / Plan*

| Regular number of work | School subjects | Contents for interactive learning | Methodology and technology of work | Multimedia interactive content | Expected outcomes |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

- Unconsciously inte-grate their experiences in lifelong learning, and the teacher sees that the student needs help in the work [3].
- Collaborative cooperative learning involves the following steps:
  - Selection and planning;
  - Setting and introduction (for ten minutes);
  - Execution and maintenance (for twenty minutes);
  - Debriefing and completion (for fifteen minutes).

All these steps can be communicated on the hours of the mother tongue from various contents. For example, content from literature, grammar, spelling, etc. They can be done in detail through the step of collaborative learning. Teachers choose teachers for co-operative learning together with students and prepare for work. In order to achieve greater efficiency, interest in work and motivation, students in the second stage can present an interesting topic, a phenomenon, perform a survey, set the problem for which students ask for explanation, ways of comparison, conceiving assumptions, predicting solutions, and the like. Learning through this kind of work requires active learning in classroom teaching. Teaching your mother tongue requires a huge job. We will agree with the fact that it is difficult to deviate from the prescribed, but teachers, teachers can make their own internal plan for maintaining interactive classes of the mother tongue, but also other subjects.

This form is one of the guidelines for how to prepare a framework preparation with certain elements of interactive time by subject. Computer support is indicated because it is possible to download interactive content from the Internet using the computer and the school network and use them at those hours, linking them to the content we are learning. Namely, interactive teaching is the teaching that applies the methods of interactive learning. These methods can be as follows:

- Team method
- Mosaic method
- Group method
- Collaborative learning,
- Co-operative mapping of maps [4]. Each type of interaction has its own significance as well as emotions that can be positive or negative. For the analysis of each interaction we can perform four aspects, such as cognitive, emotional, targeted and active. Teachers must ensure that all students are involved in interaction, and the teacher should also encourage positive emotions within the group. The aim is to develop emotional competences among students such as:
  - Emotional awareness,
  - Self-control, - self-confidence,
  - Openness to new ideas,
  - Empathy,
  - Truthfulness, etc. [4].

For some of our schools, interactive learning still represents some special and unachievable dimension, as individuals do not want to change their current way of work. Applying this method improves learning and replaces some traditional learning models. The teacher is the one who needs to evaluate what the content will do in the traditional way, which is interactive. It must be ready for lifelong learning, and in that way it will come to new knowledge and apply it in its work in school and classrooms.

*Example 2. Preparation for the interactive time of the mother tongue*

| Class and school | Teaching course | Interactive content forms and methods of work | Steps of interactive work | IT support | Planned interactive time results |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

## 4. Interactive communication in class

The communication dimension depends on the goals set. Communication communication depends on the number of participants in the interaction, as well as on the model of work. Communication can be a non-directional or completely free communication. It is then known that it can be a circular, or circular model of communication that involves the transmission of the activities of a circle. It is possible to communicate between the leader of the group and each member of the group individually, then we will interact with direct contacts, etc. [5]. There are still plenty of ways to communicate in interaction that are very complex and require special training both as a follower and a student.

*Figure 1. An example of interactive communication*[1]

This picture shows the interactive communication of all members of the group with an agreement on solving a specific set of problems to be solved. The same can be applied in working with students in classrooms on content suitable for participation of all participants in certain groups.

## 5. Methodology and results of research

The research was done in two primary schools in the Brod municipality, in the elementary school "Lijesce" and the primary school Holy Sava, through interviews. The survey included a sample of 80 respondents from the population of the classroom and 20 teachers, a total of 100 respondents. Our main tasks were to examine students whether they work with an interactive learning environment, how they choose interactive content, or even how they participate in the work, whether all members of the group are interacting, then use the Internet as an aid in the work, which can be processed interactively and the like. Then, examine the teachers how they are preparing and improving for the planning and organization of interactive classes. The paper presents only parts of the research results, as well as some of the questions asked, which provide some guidelines for future research. When asked, Are your teachers doing maternal and other teaching content in a classical way or do you participate in the work? We got similar answers, one of which is:

"One student says this: We often work in groups and we can all express our opinion. The teacher helps us work. It's interesting to work in a group and I'm glad to arrange with friends. In the group I have no fear of failure, nor do I feel ashamed to say my opinion.

"When asked, do you really do everything you do interactively and how do you choose content for interactive learning?

"Some lessons teachers work in a classical way, but often involve students in working in the way of negotiating about content for working in groups, sometimes we choose texts from the language we will do group training or reading, or proofreading, or even learning tasks spelling rules ".

Question: Do you use the Internet as an operating aid?

Most answers: "We use the Internet at home and at school, in the way that a teacher shows us various examples of group work and other ways of learning, then we find content that helps us solve a problem."

When asked, are all members of the group involved in interactive work or do they only relate to individuals?

Answer: "We often get together in the group and we all solve our tasks. Sometimes it is known that one student dominates, but encourages others to help all members of the group. "

Question: Is it more interesting and easier to work in a group or independently, individually?

1 https://www.google.com/search?q=INTERAKTIVNA+KOMUNIKACIJA

Answer: "It's easier and more interesting to work in a group. We have no fear that we will make a mistake. Usually, even if we make a mistake, we have a lot in the group, some of whom will recognize the mistake, and then we have time to correct it. We love group competition ".

Teacher Question: How to Plan and Organize Interactive Teaching? How do you improve yourself to do the same?

One of the answers: "I read literature and go to seminars searching for literature that can help me. I consult with experienced colleagues. I search on the Internet and participate in forums. I usually plan interactive lessons for a few times before. I am doing it in agreement with students and working conditions. "

Most of the students gave similar answers. Here we list only some of the answers received. It is very important that collaborators are in the mood and want to learn joint forces, which will certainly contribute to a better and more efficient teaching.

## 6. Conclusions

To conclude, teachers work in an innovative way. They are perfecting, planning and organizing interactive learning. They work with other colleagues, they go to seminars, and also use the Internet in their preparations. Students are involved in the work, which is eating the goal, converting the classic way of learning into an interactive learning approach. Students are satisfied with this way of working. They show great interest and excitement for group work. They love to progress and cooperate, help each other and say that they achieve better results. They are active in the group and are often able to negotiate with teachers about choosing content for group learning. They use the Internet for interactive content and apply them to classes in the classroom on most subjects. They achieve better results from the mother tongue from the content of grammar, orthography and literature. We can say that students are much more relaxed and more socialized with this approach of interactive learning, which is of particular importance in their further education.

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# Integrative learning pattern (science and religion) in high school

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**Abstract**

The nature of human beings is godly, and this is the basis for life in society and state, as stipulated in the Pancasila, the opening of the 1945 Constitution article 31 and the aim of national education. Efforts to integrate religion in all aspects of life are felt to be still not optimal. So education must be a motor in an effort to make it happen. This effort needs to be done; one way is by implementing integrative learning. The school's vision, mission and policy in general have supported these efforts, but there are some obstacles in its implementation. These obstacles include 1) teacher ability, 2) references, and 3) educational orientation and evaluation bias. The findings contained 3 methods carried out by the teachers: 1) Textual Method (thoriiqotun nashiyah), 2) Culturally-historical methods (thoriqot tsaqofiyah taarikhiyyah) and 3) meaning method (thoriiqotul ma'na).

**Key words:** *integrative learning, sciences, religion*

## 1. Introduction

One of the facts that assumed as starting point of the problem was 1972's separation between religious education and science. In 1972, the government issued President Decree No. 34 of 1972 about authority to organizing education which is under the Department of Education and Culture as a single door, including the authority to organize religious education. That decree followed by Presidential Instruction (Inpres) No. 15 of 1974 about the implementation of that decree. President Decree No. 34 of 1972 and Presidential Instruction No. 15 of 1974 got strong opposition from Islamic circle. The two decrees viewed as way to limited task and role of the Religious Department as well as an attempt to secularize by the New Order Government. That suspicion was quite reasonable regarding the socio-political setting that took place at the beginning of the New Order government which applied political policies that marginalized Islamic politics through weakening Islamic political parties.

The reaction was then responded with a limited cabinet meeting held on October 26, 1974. Finally President Suharto gave the following instructions and decisions: 1) the goal of national development is to achieve material and spiritual balance so there must be a balance between general education and religious education ; 2) the development of general education is the responsibility of the minister of education and culture while religious education is under the responsibility of the minister of religion; 3) the implementation of Presidential Decree No. 34 of 1972 and Presidential Instruction No. 15 of 1974 was carried out in collaboration between the education and cultural department, the Ministry of Home Affairs and the Ministry of Religion.

Based on the presidential instruction, a joint decree was issued by three ministers between the Minister of Education and Culture, the Minister of Home Affairs and Minister of Religion No. 6 of 1975; No 637 / u / 1975; and No. 36 of 1975 dated 24 of 1975 the core provisions of the three ministerial decrees were: 1) madrasas for all levels can have the same value as a equal public school diploma ; 2) madrasas graduates can continue to public schools at the same level and above; 3) madrasas students can move to public schools at the same level, so the curriculum held by madrasas must consist of 70% general subjects and 30% religious subjects. The joint decree also emphasized that the management of madrasas and the development of religious subjects in madrasas were carried out by the minister of religion [1]

The stance of the Republic of Indonesia towards the relationship of religion and science was reflected in the 1945 Constitution. The 1945 Constitution

(amendment) in article 31 paragraph 3 explains that the development of national education is oriented to increase faith and devotion to God Almighty and noble values in order to educate the lives of the nation, whereas in Article 31 paragraph 5 the development of education aims to develop science and technology by upholding religious values and national unity for the advancement of civilization and the welfare of mankind. Meanwhile the National Education System Law No. 20 of 2003 Chapter II Article 3, states that the implementation of education is oriented to the formation of fully Indonesian people, namely people who has faith and devotion to God Almighty, noble, healthy, knowledgeable, capable, creative, independent and become democratic and responsible citizens.

One offer developed by several educational institutions within the Ministry of Religion of the Republic of Indonesia is the learning of the integration of science and religion. Through this integration, it is expected to answer the complexity of the integrity of the human personality as it has been described in the objectives of national education. According to Muhammad Ali (Director General of Religion Islamic Education of the Republic of Indonesia), the integration of science and religion in learning is expected to be able to realize the development model of science and technology competencies and moral development of students together [2]. In the pattern developed in 29 Madrasah Aliyah (MA) throughout Indonesia that obtained Science and Technology Equity Program Phase 2 (STEP 2) which cooperation between the Indonesian Ministry of Religion and the Islamic Development Bank (IDB) in 2007 [2]

This paper attempts to describe the results of the research on the implementation of integrative learning in high schools. This includes the principal's policy, and the strategies taken.

## 2. Religion and Science Integration

Religion and science have different characteristics of truth. This can be seen from several definitions. Ardley defines Science as an interconnected conceptual line and scheme, and grows as a result of experimentation and observation, and is useful to be observed and experimented. [3] Whereas Gagne, as quoted by Wisudawati, argues that science must be seen as a way of thinking in the search for the secrets of nature, as a way of investigating natural phenomena, and as a body of knowledge produced from inquiry. Science is a group of knowledge that has special characteristics, namely: studying factual natural phenomena, in the form of entities or events and their causal relationships. [4] The branch of science that is a part of the current science group includes: Biology, Chemistry, Physics, mathematics, astronomy, geography, geology and so on. Meanwhile Carin and Sund defined Science as systematic and regularly arranged knowledge, applied in general (universal), and in the form of a data collection from observations and experiments [5].

Muhammad Abduh stated the need to harmonize with the Qur'an by systematic method using 5 principles, which is: 1) adjusting the events that existed in his time with the *nash-nash Al Qur'an*, 2) making the Qur'an as a unity, 3) making the *surah* as a basis for understanding the verse, 4) simplifying language in interpretation, 5) not neglecting historical events to interpret the verses that came down in his time. [6] Meanwhile Fadhil Al Djamaly, Professor of Education at the University of Tunisia, explained that all types of knowledge desired by the Qur'an must be taught to children. These sciences include: religious science, history, astronomy and earth sciences, psychology, medical science, agricultural sciences, biological sciences, arithmetic, law and legislation, social sciences, economics, balaghoh and courtesy science and countries defense science and sciences that can develop human life and enhance their level. [7]

Amin Abdullah (2004) explains that the Islamic world needs to seek integration of religion and science (de-secularization). Single entity religious character where religious knowledge stands alone without the need for the methodology used by general science and its relation to isolated entities science (each science groups stands alone, knows the existence of another group of science but does not methodologically intersecting), need to be synthesized with the interconnected entities model. This model is based on the knowledge building, each of which is aware of its limitations in solving human problems, and then establishes cooperation at least in terms the approach, thinking methods and research methods (process and procedure). [8]

### 3. Integrative learning of Religion and science

Beane in Hartono, explains integrative learning centered on important issues in the school curriculum with the wider world. Integration will connect problems with one another, so that unity of knowledge wass built. A knowledge that presents the unity of parts with a whole knowledge (part-whole relationship). [2] While Amin Abdullah explained, integrated / integrative education is one model that eliminates the dichotomy of education, between the social environment and students with different ethnicity, race and religion, between customary norms and religious norms, including the political problems of a nation. Education becomes enlightenment for humans in carrying out their life activities without being burdened by a particular ethnic, racial, religious or political difference. Therefore integrative education is one of the media to develop humanist education [9].

The implementation of education by emphasizing on learning that separates presentation between subjects with subjects with other subjects will result in incomplete students knowledge even though in their daily life, students are used to seeing and studying events that occur more broadly or experience them as a whole (holistic ), not partial / separate. Learning that explicitly separates the presentation of subjects, will only produce difficulties for each student, because it will only provide an artificial learning experience or a fabricated learning experience. Therefore the learning process must give attention to the characteristics of students who will appreciate the learning experience as a whole that is unified [10].

Davies and Brown in a journal with the theme "A Programmatic Approach to Teaming and Thematic Instruction" explained that collaborative planning in thematic learning is one of the instruments for creation and testing, and sharing about the content of subject matter and learning experience that shows the connection between good conceptual elements within and between subjects. This will provide opportunities for effective and more meaningful learning [11], because science and religion are one unit since the main source is only one, namely Allah SWT. Humans only try to dig it to get that knowledge. [12] Sardar expressed the need to create theories of education systems that combine the best features of traditional systems and modern systems. This integralistic education system must centrally refer to the concept of Islamic teachings [13].

Ahmad Sanusi explained that in the teaching and learning process that is Islamic in nature, it needs to be accompanied by a foundation of a system of mega-values, which is called *Ilahiyat*. The *Ilahiyat* System includes: 1) sourced from Him (*minallah*), 2) to return to Him (ilallah), 3) in the process of always being with Him (*ma'allah*), 4) actively working thanks to His strength (*billah*) and 5) everything is offered to Him (*lillah*). [14] Whereas Lickona explained that to form moral people need a main reference, which is religion. Moral life, ethics can deliver someone to have a good character (intact). There are three basic components forming characters. First, it is moral knowledge which includes moral awareness, knowledge of moral values, perspective determination, moral thinking, decision making and personal knowledge. Second are moral feelings that include conscience, empathy, self-esteem, self-control, loving good things and humility. Third are moral actions which include desire, competence and habit. Moral knowledge, moral feelings and moral actions do not function as separate parts, but penetrate each other and influence each other in any methods or ways [15].

### 4. Research Method

This study used descriptive qualitative method. This method used because the research aims to describe systematically and factually about how the implementation of integrative learning with a qualitative approach. This method used to solve the research problem in order to extract data and information relating to the implementation of integrative learning. To get objective data in this research, the author uses certain data collection methods and techniques. As of Surakhmad said that methods are the main way used to achieve goals. This research is a qualitative research, viewed from the root, data analysis and objectives. [16] As the opinion of Moleong, which says:

Qualitative research was rooted in a scientific background as a whole, qualitative research relies on humans as research, utilizes qualitative meth-

ods, data analysis inductively directs research objectives to attempt to find theory from the basis, tend to be descriptive and emphasizes the process rather than results. [17]

The use of this method is in accordance with the main purpose of this research, which is to describe the implementation of integrative learning in MAN 02 Brebes and SMAN 01 Bumiayu. Through this qualitative approach, the researchers will try to observe the activities of people in the school environment: principals, teachers and students related to the research focus.

### 5. Integrative Learning Pattern at School

Part of the school's vision was already linear with integrative learning goals. For examples the vision of MAN 02 Brebes, "*Cerdas-Islami, TRAmpil MANfaat, Daya Unggul ber Akhlak (CITRA MAN DUA*)" (Smart-Islamic, skilled benefited, morally excellent) and the vision of SMA Negeri 01 Bumiayu, "*mewujudkan peserta didik yang berakhlaq mulia, unggul dalam prestasi, cinta lingkungan, dan berbasis ICT"*

(Realizing students who are noble, excel in achievement, love the environment, and based on ICT). While the mission carried were also quite supportive such as: "*Menanamkan nilai-nilai Islami dalam pendidikan, dan Menyiapkan generasi muslim yang memiliki IMTAQ dan IPTEK serta berkepribadian akhlakul karimah* (MA Negeri 02 Brebes)" (Raising Islamic values in education, and Preparing Muslims generation who have faith and piety, Science and Technology as well as akhlakul karimah personality (MA Negeri 02 Brebes). Meanwhile for SMA Negeri 01 Bumiayu "*Menumbuhkan penghayatan dan pengamalan nilai-nilai agama* yang *di anut dan budaya bangsa"* (Cultivate appreciation and practice of religious values embraced and nation culture)

This vision and mission is further break down in the program: 1) carrying out joint discussions and studies between religious teachers and quarterly subject teachers. The result of this activity is in the form of dictates or subject teachers handbooks in integrating subject matter with the qur'an and hadith, 2) working meetings of principals (MKKS). Generally, this activity discusses the efforts to internalize the vision and mission in learning, one of them is religious values, 3) Meetings of subject teachers (MGMP), technically, this activity discusses implementative efforts to internalize religious values in learning, 4) complete the references which support integrative learning and 5) make the implementation of learning as an additional assessment of teacher performance by the principal.

Most of the teachers have implemented integrative learning, although there are differences consistencies in their implementation. Most teachers think religion can be linked 100% because the Qur'an and Hadith must be scientific, but some of them argue that not everything can be linked. In some cases the Qur'an and hadith can be contrary to science (scientific theory). In response, the teachers have the same opinion, that science must be wrong while the Qur'an or Hadith must be true, or need to find the meeting point between them.

Integration between science (Physics, Chemistry, Biology, Science and Geography) with the science of religion will be maximized if the results are carried out comprehensively. This integration can include the principal's policy, curriculum, syllabus, lesson plans, learning process, textbooks, learning resources / materials / media and learning environment. The opinions of teachers in MAN 02 Brebes and SMA Negeri 1 Bumiayu are relatively the same, as illustrated in the table 1.

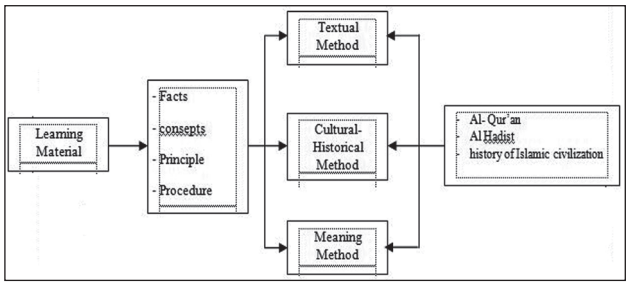
Teacher creativities in implementing integrative learning can be grouped into 3 methods:

*Table 1. The opinions of teachers in integration between science (Physics, Chemistry, Biology, Science and Geography) with the science of religion*

| No | Education Institutions | Percentage | | | Total |
|---|---|---|---|---|---|
| | | All | Part | Abs | F/% |
| 1 | MAN 02 Brebes | 20 | 80 | 0 | 100 |
| 2 | SMAN 01 Bumiayu | 22 | 78 | 0 | 100 |

1. *Textual method* is a method of integration in learning between learning material with the Qur'anic and hadith text (*thoriiqotun nashiyah*) For examples:
   - Ecological, ecosystem and natural balance material (10th year, 2nd semester). The teacher associates with QS Ar Ruum; 41, "There has been damage on land and in the sea due to the actions of human hands, so that God feels to them part of their actions, so that they return (to the right path)."
   - Atomic material (10th year, 1st semester). In this discussion the teacher connects with QS az Zariat: 49, "and all things We create in pairs, so that you remember the greatness of Allah." In each atom consists of electrons which are negatively charged (-) and neutrons which are positively charged (+)
2. *Cultur-histosrical method* is the method of integration in learning between learning material with the history of Islamic civilization, Muslim intellectual figures and his works related to the subject matter of discussion (*thoriqot tsaqofiyah taarikhiyyah*). For examples:
   - Hormonal and immune system material (11th year, 2nd semester). On this topic the teacher explained that Rosulullah has excellent stamina / endurance. This is because the Prophet Muhammad had the right lifestyle (mindset, diet, taste patterns, behavior patterns). Therefore, the Prophet Muhammad SAW became *uswatun khasanah* for humans. In addition the teacher also associates with fasting. Because fasting is the custom of the Prophet Muhammad. Fasting can increase the body's immune system by increasing white blood cells.
   - Optical and lens material (10th year, 1st semester). The teacher explained a Muslim figure named Ibn Haitham who discovered the technology of glasses, cameras, binoculars and other optical and lens technologies.
3. *Meaning Method* is the method of integration in learning between learning material and Islamic values, although the text directly related to the subject matter has not been found (*thoriiqotul ma'na*). For examples:
   - Atomic structure material (10th year, 1st semester). According to science the matter of atoms is considered to be the smallest thing, where this atom consists of protons and nuclei. This small object cannot be felt by its existence, and to see it humans need a tool that is a microscope. While the parable of the smallest thing in the Qur'an is called *zarroh*. QS. Al-Zalzalah 7-8 explains: "and whosoever works good things as big as the seed of the *zarroh*, surely he will receive his reward, and whosoever does evil as big as the seed of the *zarroh*, surely he will receive the reward." So in this material the teacher integrates with 2 (two) attributes of Allah, namely: *Bashor* (the Most seeing) and *al-'Adl* (the Most Just). Allah sees everything we do (good / bad), even though it is a very simple matter (small) and Allah will surely take into account the hereafter.
   - Energy conservation law material (odd semester XI class). In this material I associate the eternity of energy with no futile human effort. Human physicality is impermanent, but its deeds (good or bad) will make it eternal. I connect with QS Al Zalzalah 7-8, "Whoever does good works as weighs as dzarrah, surely he will see (reply). And whoever commits evil is as much as *zarrah*, surely he will see (reward) too "

In the integrative learning process found an integrated learning flow. First, the teacher determines the subject matter to be taught; second, the teacher identifies facts, concepts, principle and procedures related to the material, and thirdly, the teacher relates them to the Qur'an, Hadith and the history of Islamic civilization. From this integration process there are 3 methods: 1) Textual Method, 2) Cultural-historical Method and 3) Meaning method. If it simplified, the flow of the method used can be described as follows:




*Picture 1. Techniques to integrating religion and science in learning*

## 6. Conclusion

Religious integrated education policies and sciences are one of the ways for schools to carry out the mandate of the law. This is stated in the first *sila* of the Pancasila and the opening of the 1945 Constitution - The 1945 Constitution (amendments) in Article 31 paragraphs 3 and 5, Law on National Education System No. 20 of 2003 Chapter II Article 3.

The principal is given space to make policies in managing the school (Manajemen Berbasis Sekolah dan Manajemen Peningkatan Mutu Berbasis Sekolah). The principal has made a policy that supports efforts to implement integrated learning; this can be seen from the school vision and mission that is carried out and the programs that are set.

Most teachers realized and supported the implementation of integrative learning, although there are obstacles in the implementation process. The obstacles that arise include: 1) the ability of teachers in implementing integrative learning is still lacking, 2) references that support integrative learning are still limited and difficult to find, 3) integrative learning has not become a national policy, especially in the learning evaluation. The learning orientation of learning was more focused on science subjects only.

The teacher has enough creativity in carrying out integrative learning. The form of creativity carried out can be grouped into 3 methods: 1) Textual Method, 2) Culture-historical Method and 3) Meaning method.

Need serious efforts from all parties to realize national education goals, both from the policies of the central and regional governments. It is also necessary to seek integrative learning training for teachers and increase the number of references.

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