

The Impact of the Integration of Islamic Learning and Science through Virtual Mechatronics Approach to Student Learning Outcomes at UIN Sunan Gunung Djati Bandung, West Java, Indonesia

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ABSTRACT

This paper investigates the impact of the integration of Islamic learning and science through virtual mechatronics approach to student learning outcomes in the line of revelation guides sciences as a scientific paradigm developed at UIN Sunan Gunung Djati Bandung. This paradigm was implemented in the form of the integration between Islamic learning and science as an academic tradition. One of which is through virtual mechatronics approach in the process of Islamic learning and science at Department of Physics Education, Faculty of Education and Teaching, UIN Sunan Gunung Djati Bandung. The results of the previous learning evaluations show that the students are more knowledgeable in the field of Islamic learning than applied science, but after the integration of sciences through a virtual mechatronics approach, they are proven to be more familiar and master in applied science. In the other words, they are not only proven the knowledge of Islamic learning and science theoretically, but also can solve the various cases around religious issues through using the scientific approach. The results of this study can be referenced and useful for integrating Islamic learning and science with various approaches to other learning processes.

Keywords: integration, Islamic learning, science, virtual mechatronics, learning outcomes

INTRODUCTION

The dichotomy between religion and science has become a serious debate among Muslim scholars, especially those who are deeply influenced by the doctrine of materialism, deity reason, and put aside religious values. This thinking method is seen by some Muslim scholars to have neglected the elements of theology, in which human reason is increasingly distanced from theology because it is subjected to pure rationality and not guided by revelation.

A number of Western Scholars have conducted various scientific researches that science is assumed to be a tool to make changes to human civilization as well as knowledge as the source of civilization. One example is Charles Robert Darwin who developed the theory of evolution. He explained that the process of creation of living things and natural changes is not created by God's will but it is resulted by natural phenomena that guide every living creature to adapt with their habitat (Natsir, 2005).

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The dichotomy problem between religion and science is not only within discussion and scientific research among Muslim scholars, but also becomes a kind of opiate in the curriculum system and learning process. Islamic State Universities or PTKIN as the tertiary institution under the Ministry of Religion of the Republic of Indonesia has the main task to develop education, research, and community service. They have also a specific duty to prepare graduates who have the ability in the fields of Islamic studies and science, able to educate the nation, and realize the society welfare.

In response the development of Islamic education, the Ministry of Religion of the Republic of Indonesia implemented a policy to develop PTKIN. Institutionally, PTKIN in Indonesia is developed and classified into three forms, namely STAIN, IAIN, and UIN. STAIN has only a few majors or study programs, has no faculty, and only focuses on organizing higher education in the field of Islamic studies. IAIN has several faculties, departments, and study programs that only focus on organizing higher education in the field of Islamic studies. Whereas UIN has many faculties, departments, study programs, and is not only focused on organizing higher education in the field of Islamic studies, but also focusing on developing science and technology.

The development policy was also adopted by UIN Sunan Gunung Djati Bandung, West Java, Indonesia. Initially, IAIN Sunan Gunung Djati Bandung was established on April 8, 1968 based on the Decree of the Minister of Religion of the Republic of Indonesia Number 56 of 1968 and only had 3 Faculties such as Sharia, Tarbiyah, and Ushuludin. In 1993, IAIN Sunan Gunung Djati Bandung added more two new faculties, namely Adab and Dakwah (Setiadi, 2010).

During the 2003-2008 periods, they were formed a consortium institution to develop the paradigm of science that aimed to integrate Islamic studies and sciences in the framework of revelation guides science. Scientific studies at the consortium institution have produced three important formulations such as: first, changes in the nomenclature of institutions, faculties, and study programs; second, changes in the curriculum and learning system; and third, changes the titles and designations of the graduates (Yusup, 2012).

The recommendation of the consortium study have also resulted the changes of the institutional status from IAIN Sunan Gunung Djati Bandung to UIN Sunan Gunung Djati Bandung based on Presidential Regulation Number 57 of 2005, which in Article 5 of the regulation states that the task of UIN is to develop Islamic studies and scientific disciplines. Finally, UIN were form three new faculties namely (a) Faculty of Science and Technology; (b) Faculty of Psychology, and (c) Faculty of Social and Political Sciences (Athoillah, 2012).

Until now, UIN Sunan Gunung Djati Bandung, West Java, Indonesia has already 9 faculties including postgraduate programs. During the 2015-2019 periods, the consortium has also conducted various new studies to integrate various scientific disciplines. The result is recommending for the establishment of two new faculties namely: (a) Faculty of Islamic Economics and Business, and (b) Faculty of Medicine and Social Health (Athoillah, 2016).

An interesting phenomenon that will be carried out more comprehensively in this paper is not explore about the problem or impact of the change of institutional status, but the problems and impacts of the integration of Islamic studies and science to the student learning outcomes. In some cases, lecturers and students still have difficulty in integrating Islamic studies and science within learning process to be in accordance with the paradigm of revelation guides science. In addition, they also still find a number of the difficulties about how to arrange curriculum and delivers the teaching materials to the students in learning process through various strategies both are interdisciplinary and multidisciplinary approaches.

One of the examples that will be explored in this paper, there are a small number of the lecturers at Department of Physics Education, Faculty of Education and Teaching, UIN Sunan Gunung Djati Bandung who have succeeded in carrying out several innovations. They have used a virtual mechatronics approach in the process of learning physics. Although this approach is not yet popular among UIN lecturers, the limited ability of reasoning, knowledge, skills, and optimization of facilities and infrastructure have resulted the student learning outcomes better.

LITERATURE REVIEW

The Integration of Islamic Studies and Science

Integration can be generally defined as a process of system change and the integration of various aspects into a unified whole. Mustopo (2017) explains that the term of integration is etymologically derived from

English word, “integrate” and “integration”. Echols and Shadzily (2003) define the word of integration by merging, uniting, or combining into one integrated whole. Partanto and Al-Barry (1994) define the integration of science as the integration of separate sciences into the one cohesion of knowledge. In this context, it is simply understood as the union between the religious studies and sciences.

According to Ruswantoro (2007), the integration between religious studies and science is an effort to fuse polarism between religious studies and sciences caused by dichotomous mindset changes between religion as an independent source of truth and sciences as an independent source of truth. This definition is based on new formulation thought among modern philosophers to eliminate the dichotomy of knowledge that is seen separately between one to each other. They argued that each discipline did not stand alone, but needed and complemented to each other, including also the integration between Islamic studies and sciences.

Nasution (2017) says that there are two approaches to integrate between Islamic studies and sciences: first, interdisciplinary approach is an approach to solve the problems through various perspectives that is relevant or appropriate in an integrated manner. For instance, the lecturers have implemented the integration between Philosophy and Sufism at Faculty of Theology through the application of heuristic methods and interdisciplinary approach. Second, a multidisciplinary approach is the merging of several disciplines to jointly overcome a particular problem. For instance, the lecturers implement the integration between Psychology and Legal Studies at Faculty of Sharia and Law through the application of problem solving methods and multidisciplinary approach.

The specific objective of integration between Islamic studies and science is expected to eliminate the dichotomy of knowledge in the learning process, where each lecturer can provide Islamic learning materials combined with the science. In addition, the general objective is also to realize the integration of various actual scientific disciplines, especially for someone who explains the material of religious studies that is supported by facts in science and technology.

Learning Strategies

The term of strategy comes from the Latin, “strategia”. It is interpreted as the art of using plans to achieve goals. According to Frelberg and Driscoll (2000), learning strategies can be used to achieve the various objectives of providing subject matter at various levels, for different students, and in different contexts. They explained that learning strategies is used to achieve various objectives of providing subject matter at various levels, for different students, and in different contexts.

Dick and Carey (2004) said that learning strategies are the chosen ways to convey subject matter in a particular learning environment, including the nature, scope, and sequence of activities that can provide learning experiences to the students. They argue that learning strategies are not only limited to the procedure of activities, but also include learning materials or packages. The learning strategy consists of all components of the subject matter and procedures that will be used to help students achieve certain learning goals.

Gerlach and Ely (1980) explain that learning strategy can be interpreted as a pattern of learning activities that are selected and used by the teacher contextually, to be in accordance with the characteristics of the students, school conditions, the surrounding environment, and the specific learning objectives formulated. They also said that there needs to be a link between learning strategies and learning objectives, in order to obtain effective and efficient of learning activities. Newman, Logan, and Makmun (2003) explained that learning strategies is divided into two approaches: first, student-oriented or student-centered learning approaches; and second, learning-oriented or student-centered approaches teacher (teacher centered approach).

Relating to the learning models in the context of the integration of Islamic studies and science, I refer to the view from Abdullah (2006) who mentioned that there are four groups of learning models: first, social interaction models; second, information processing models; third, personal-humanistic model; and fourth, behavior modification models. Nevertheless, the term learning model is often used to identify the learning strategies.

Virtual Mechatronics Approach

According to Vesto (2019), virtual mechatronics is the perfect tool to step into the world of industrial automation. The students acquire basic theoretical knowledge for every single technology prior to the hands-on and skill-based training, which is performed on real equipment. The genealogy of virtual mechatronics is

derived from the term of “mechatronics” in English, and “mechatronik” in Germany. The word is very popular studied in mechanical science, electronics, computer, and informatics engineering.

Nutaro (2019) says that the word mechatronics originated in Japanese-English and was created by Tetsuro Mori, an engineer of Yaskawa Electric Corporation. The word mechatronics was also registered as trademark by the company in Japan with the registration number of “46-32714” in 1971. However, afterward the company released the right of using the word to public, the word begun being used across the world. Nowadays, the word is translated into many languages and the word is considered as an essential term for modern industry. For instance, according to Mechanical and Mechatronics Engineering Department (2019), French standard NF E 01-010 gives the following definition: “approach aiming at the synergistic integration of mechanics, electronics, control theory, and computer science within product design and manufacturing, in order to improve and/or optimize its functionality”.

Bradley (1993) explains that virtual mechatronics is inherent with the term of mechatronic engineering, which is a multidisciplinary branch of engineering that focuses on the engineering of both electrical and mechanical system, and also includes a combination of robotics, electronics, computer, telecommunication, system control, and product engineering. Karnopp (2006) and Cetinkunt (2007) say that as technology advances over time, virtual mechatronics is used to various subfields of engineering have succeeded in both adapting and multiplying.

In practice, the intention of mechatronics is to produce a design solution that unifies each of these various subfields. Originally, the field of mechatronics was intended to be nothing more than a combination of mechanics and electronics, hence the name being a portmanteau of mechanics and electronics; however, as the complexity of technical systems continued to evolve, the definition had been broadened to include more technical areas.

Until now, virtual mechatronics approach is not only used by the lectures who teach science and technology, but also familiar with other lectures who teach Islamic studies like at UIN Sunan Gunung Djati Bandung. They practiced it in various methods and approaches with these highlights: first, Web-Based Training packages (WBTs) combined and managed via Classroom Manager; second, Programming and Simulation Software to develop programming skills in different technologies; third, Classroom Manager as the quick and easy way to create, manage and supervise training sessions and courses; fourth, Excellent didactic and multimedia course topics; Learning scenarios can be individually customized; and fifth, Connected Learning with Tec2Screen as an innovative learning methodology that makes complex technologies easy to understand.

Learning Outcomes

According to Berryman (2010), learning outcomes is the statements that describe the knowledge or skills students should acquire by the end of a particular assignment, class, course, or program, and help students understand why that knowledge and those skills will be useful to them. They focus on the context and potential applications of knowledge and skills, help students connect learning in various contexts, and help guide assessment and evaluation. Allan and Clarke (2007) describe good learning outcomes emphasize the application and integration of knowledge. Instead of focusing on the coverage of material, learning outcomes articulate how students will be able to employ the material, both in the context of the class and more broadly.

According to Adam (2019), the distinction between learning outcomes and learning objectives is not universally recognized and many instructors may find that the term ‘learning outcomes’ describes what they have already understood by the term ‘learning objectives’. Some scholars make no distinction between the two terms; those who do usually suggest that learning outcomes are a subset or type of learning objective. Learning objectives, for example, may outline the material the instructor intends to cover or the disciplinary questions the class will address. By contrast, learning outcomes should focus on what the student should know and realistically be able to do by the end of an assignment, activity, class, or course. The same goals addressed by learning objectives can be equally addressed by learning outcomes, but by focusing on the application and integration of the course content from the perspective of the student, learning outcomes can more explicitly and directly address expectations for student learning.

For instance, according to SPMI (2019) the expected learning outcomes of graduates from the Bachelor Degree Program have been formulated based on a combination of the Indonesian National Qualification Framework (INQF), the National Standards of Higher Education (NSHE) Number 44 of 2015, and the work profile of physics graduates of undergraduate programs in physics education. The competencies of

undergraduate graduate program are expected to have reflected the professional needs in the fields of physical education and management required by stakeholders.

Based on the policies, the current curriculum arranged at Department of physical education (2014-2019) has been developed to be based on the learning outcomes needed in the INQF. The learning achievements of the bachelor degree graduates from Department of Physical Education are categorized in the following three terms: first, mixed work fields: able to analyze technical problems based on physical engineering (instrumentation, energy and environmental conditioning, materials, vibration and acoustics, and photonics) and able to play an active role in solving problems in the Industry; second, knowledge that is mastered: mastering and able to integrate the science of physics engineering covering the fields of expertise: instrumentation, energy and environmental conditioning, materials, vibration and acoustics, and photonics, for the development of science and technology; and third, managerial ability: able to make decisions about system of problem solving in an appropriate, rational, and professional manner based on physical education sciences by prioritizing concern for the socio-cultural environment.

In INQF scope, learning outcomes is defined as the ability acquired through internalizing knowledge, attitudes, skills, competencies, and accumulated work experience. It also must be inherent with the measurement of what someone gets in completing the learning process both structured or not and as a formulation of learning objectives to be achieved and must be owned by all study programs, is also a statement of the quality of graduates.

Abdullah (2006) says that learning outcomes and learning objectives are included within the NSHE that was regulated under the Ministry of Education and Culture Regulations Number 49 of 2014. The regulation is a standard unit that includes the National Education Standards, plus the National Standards for Research, and the National Standards of Community Service. It is also the legal basis for formulating learning outcomes for the graduates of higher education institution; especially the provisions contained in one of the national standards namely Graduates Competency Standards (GCS).

In this context, learning achievement formulation is arranged in four education elements, namely attitudes and values, work ability, mastery of knowledge, and authority and responsibility. In general, the functions of these formulations consist of seventh components such as: first, curriculum components and the quality assessment tools of graduates; second, the characteristics of study program specifications; third, size of the qualification level; fourth, reference list for curriculum evaluation; fifth, references for equality recognition; sixth, comparative educational attainment; and seventh, the main completeness of the description in the Certificate of Companion Graduate Document (CCGD).

METHOD

This paper is based on the research which uses descriptive-analytical method through the combination of bibliographical and empirical approach. These methods and approaches are used to explain the impact of the integration of Islamic studies and science through virtual mechatronics approach to student learning outcomes in the line of revelation guides science as a scientific paradigm developed at UIN Sunan Gunung Djati Bandung. Primary, secondary, and tertiary data sources are derived from the number of literatures that are closely related to the research objective. While the data collection techniques obtained from book review, documentation, and the other sources that relevant with the main topic of this research in line of the impact of the integration of Islamic studies and science through using the virtual mechatronics approach to the student learning outcomes at UIN Sunan Gunung Djati Bandung. Analysis of the data consists of the steps of compilation, classification, and analysis of the data which are done deductively and inductively until the formulation of conclusion.

RESULT AND ANALYSIS

The Scientific Paradigm of UIN Sunan Gunung Djati Bandung

This research shows that to realize the scientific integration platform at UIN Sunan Gunung Djati Bandung, the effort of curriculum system is designed to formulate the form of science integration based on the philosophical framework systematically. The formulation of the philosophical framework here is mean the basic scientific framework, which reflects the integration of various scientific disciplines in a unified whole. This philosophical framework is closely related to the vision and mission, the strategy of developing knowledge and science, including the objectives to be achieved by the institution.

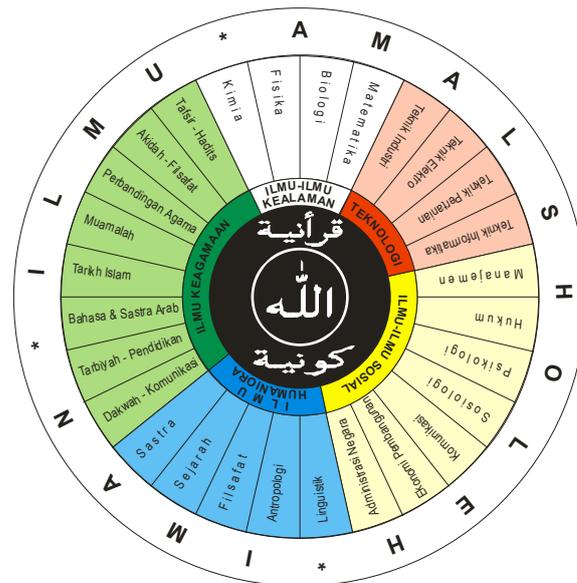


Figure 1. Scientific Paradigm of Revelation Guides Sciences

During the recent decades, the founding fathers of UIN Sunan Gunung Djati Bandung have fought to realize the idea of its formation. They have a dream that UIN Sunan Gunung Djati Bandung is expected to become one of the world class universities under the Ministry of Religion, which has advantages in various fields, both in terms of infrastructure and supra structure. In the meantime, the scientific integration of UIN Sunan Gunung Djati Bandung curriculum system is analogous to two inseparable sides of the coin, religious knowledge on the one hand and general science on the other. Synergistically the two are interconnected and complementary so that there is a fusion of religious studies and science in the frame of revelation guides science.

The desired scientific framework in the curriculum system of UIN Sunan Gunung Djati Bandung platform is addressed to eliminate the dichotomy of religion and science. As explained at the beginning of this paper, knowledge and science have developed along with the dynamics of human thought. They were born not only from deep reasoning towards the objects of knowledge (Qauniyah verses) contained in God's material, but more importantly is God himself as the source of all sources of knowledge itself (Quraniyah verses). Through the combination between Quraniyah and Qauniyah verses, there will be resulted a scientific paradigm based on revelation and rationality.

The desired dynamics in scientific paradigm and curriculum system at UIN Sunan Gunung Djati Bandung curriculum system are based on "wheel philosophy". "Wheel" is a parable of scientific dynamics in accordance with changing times. The scientific wheel continues to rotate on its axis in the direction of the development of human thought and civilization, across space and time by remaining grounded in the "pillar" element of the wheel as the most essential or fundamental force for the dynamics of science itself.

According to Tafsir and Natsir (2011), the intact scientific paradigm of UIN Sunan Gunung Djati Bandung is framed in a wheel metaphor. The wheel cycle is the basis in developing curriculum at UIN environment. The wheel cycle can be simplified in what is referred to as the scientific triangles at UIN Sunan Gunung Djati where each angle is known as the Quran and the Sunna, philosophy and ethics, and also the natural sciences, humanities and society. Furthermore, through a holistic integrative approach, an integrated truth of revelation is formed in the line of scientific studies related to texts with the evidences found in the universe and in the form of social, humanioral and natural sciences, including also their development related to Islamic philosophy and ethics. This paradigm will also form the personalities of Muslim scholars who have the strength of faith, the broadness of knowledge, the piety of manner, and the superiority of deeds. Shortly, the development of various scientific disciplines is manifested into a form of science integration at UIN Sunan Gunung Djati Bandung as illustrated in **Figure 1**.

Mechanically, a wheel is a motor device that causes motion to occur in a vehicle. Without wheels, a vehicle of course cannot move from one place to another. However, the wheel philosophy here is mean that UIN Sunan Gunung Djati Bandung is like a vehicle that runs, while the curriculum platform is a scientific paradigm

developed in it. Thus, the specific identity inherent at UIN Sunan Gunung Djati Bandung is one of Islamic Higher Education Institutions that developed various disciplines both Islamic studies and science in a unified whole.

In a wheel system, Praja and Natsir (2011) described that there are three main components namely the axle or (as), the spokes (wheels) and tires (tires). These components work simultaneously in accordance with their respective functions. Even when the wheel is spinning, each component functions according to its function organically and mechanically. If likened to wheel philosophy, the scientific paradigm at UIN Sunan Gunung Djati Bandung curriculum system can be explained as follows:

First, the axle (as) function is the most vital component, and at the same time it is the center of the wheel movement. It is the main fundamental, and at the same time it is also the source of all human knowledge which is based on revelation and reason. The central point of the axle is the sacred divine verses, teaching the truth, being a source of science and science and at the same time a guide for human life (way of life). The centrifugal force of the axle reflects revelation as a source of science and science, which in turn will develop into various fields of science both religious and general sciences. On the contrary, the centripetal force reflects all fields of science and their usefulness must be in line and return to the axle itself which is the divine verse or the Quranic verses. In short, the scientific paradigm developed at UIN Sunan Gunung Djati Bandung curriculum system is the identity of the scientific paradigm that originates from the divine verse and returns to the divine verse.

Second, the function of the alloy is consisting of the inner and outer spokes supports by the scientific family and disciplines. The clusters of sciences and disciplines have their own characteristics. Each field of sciences stands alone according to the object of the study and methodology. The fields of sciences are translations of verses of *Qauniyah* found in all the creations of God Almighty. Each of these fields of science will develop dynamically and holistically in accordance with the demands and changes of the times by not leaving its basic foundation of revelation, reason and heart. Thus, the curriculum system at UIN Sunan Gunung Djati Bandung will be a diversity of fields of science in the form of a combination of *Quraniyah* and *Qauniyah* verses from the beginning, the process, and to the end.

Third, the outer tire is a parable of the ideal formed of the integration of Islamic studies and science within the curriculum system at UIN Sunan Gunung Djati Bandung. The ideal formed here is mean that UIN Sunan Gunung Djati Bandung has the general goal of preparing graduates who are smart, capable, skills, and have noble character. The objective is a representation of the implementation of faith, knowledge and good deeds in wheel philosophy. The power of faith is a buffer for personal monotheism for all graduates from UIN Sunan Gunung Djati Bandung. The power of knowledge is the ability or bargaining power possessed by UIN Sunan Gunung Djati Bandung. While the power of charity *sholeh* is a wise attitude and character based on the strength of faith and breadth of knowledge in each individual graduates from UIN Sunan Gunung Djati Bandung. Thus, a strong faith, broad mastery of knowledge and wisdom in noble character is one of the desired goals in preparing its graduates by UIN Sunan Gunung Djati Bandung.

Through the integration between Islamic studies and sciences in the frame of revelation guiding science, the development of curriculum system at UIN Sunan Gunung Djati Bandung in the future is structured to equip students and graduates who have adequate levels of knowledge and expertise relevant to the needs of the community and employment based on the paradigm of revelation guides sciences. The expected output is the formation of a curriculum structure that is relevant to the needs of the community based on the paradigm of revelation guides sciences. The expected outcome is also the application of the integralistic and holistic scientific epistemological building can be implemented based on the paradigm of revelation guides science.

The Classification of Sciences at UIN Sunan Gunung Djati Bandung

In accordance with the philosophy of the scientific integration wheel at UIN Sunan Gunung Djati Bandung, Athoillah and Natsir (2017) explained the classification of sciences in the curriculum system can be described in the framework of integration of *Quraniyah* and *Qauniyah* verses such as follows:

First, ontologically the classification of sciences in the curriculum system at UIN Sunan Gunung Djati Bandung emphasizes the development of sciences that is built on truth, revelation, reason and heart. Truth is not based on science, which is based on materialism as adopted by Western thinkers in the renaissance period, but also placed in the essential truth within the form of a integration between Islamic studies and science without dichotomy.

Second, epistemologically the classification of sciences in the curriculum system at UIN Sunan Gunung Djati Bandung is carried out through a comprehensive study of all fields of sciences. The assessment of the field of sciences is adjusted to the demands and needs of the community, so that the results of the assessment can provide benefits for the community. Therefore, UIN Sunan Gunung Djati Bandung is directed to become a research university that is subject to the dynamics of scientific studies in accordance with the three goals of higher education namely education, research, and community service. The logical consequence of a research university is the need for adequate infrastructure and superstructure supports for academic activities.

Third, axiologically the classification of sciences in the curriculum system at UIN Sunan Gunung Djati Bandung is addressed to prepare graduates who are smart, capable, skilled, and have of good character, so that they are capable to use their knowledge and skills when they are returned to the community. Even more than that, the ideal goal of UIN Sunan Gunung Djati Bandung graduates is to prepare graduates who are able to bring change in society (the agent of social change) and care about the destiny of the nation (the agent of social control), and have a high social sensitivity (agent of social responsibility).

Based on this frame mentioned above, I would like to refer to Najib, Setiadi, Yusup, and Irfan (2008) who explained that the discussion of various disciplines in curriculum system and the mention of academic degree at UIN Sunan Gunung Djati Bandung refer to the Ministry of Religion Regulation Number 3 of 2016, which can be classified such as in **Table 1**.

Strategies and Approaches in Designing Curriculum and Learning

In an effort to integrate between Islamic studies and science, it is clearly needed an appropriate strategy to be in accordance with the needs of scientific paradigm at UIN Sunan Gunung Djati Bandung, which is referring to the Indonesian National Qualification Framework (INQF) and the National Standards of Higher Education (NSHE) regulated in the Ministry of Education and Culture Regulation Number 44 of 2015. It must be tailored to the demands and needs of the community. In this context, it must be also recognized that the integration between Islamic studies and science is not actually easy to be done, because each discipline is grounded in an independent scientific foundation. So that several study programs, departments, and faculties at UIN Sunan Gunung Djati Bandung should be directed towards scientific specialization according to their fields.

In this regard, the integration of Islamic studies and science at UIN Sunan Gunung Djati Bandung is not in terms of the classification of the subjects, but on the scientific objects. In other words, religious values must be transformed into various other scientific disciplines. This kind of condition is not without risk, because later the fields of Islamic studies will only be considered as a complement to other fields of science that are more popular and popular with the public. In short, if the integration between Islamic studies and science only prioritizes the aspects of its object, pragmatically there will be a tendency for an ambivalent attitude to accept the integration of religious values into other sciences.

To limit the deadlock of the epistemology of the integration between Islamic studies and science, it would be better if there is a common understanding between the components involved in the preparation of scientific framework. In this context, UIN Sunan Gunung Djati Bandung must have a new curriculum and learning formulation that have specificity and different from other UIN in Indonesia. The specificity here is mean that the development model of the integration between Islamic studies and science in curriculum system will not produce the paradoxes in understanding Islamic studies and sciences. Something needs to be underlined here is how far UIN Sunan Gunung Djati Bandung become one of the State Islamic University models that has succeeded in developing science and technology based on religious values. The most positive choices are the development of strategies and approaches in the learning process through interdisciplinary and multidisciplinary studies.

In interdisciplinary and multidisciplinary studies approaches, the patterns of education, learning process, and research activities are not only carried out from a single perspective, but can be reviewed from various perspectives, approaches, methods, and models that combined the field of Islamic studies and science. For example, interdisciplinary and multidisciplinary studies at Faculty of Law, Emory University, State University of New York, and Harvard University (United States), Faculty of Art and Sciences, University of Melbourne and University of Western Australia (Australia), and Faculty of Art and Sciences, Leiden University and Tilburg University (the Netherlands) where succeeded in integrating Islamic legal studies with jurisprudence at Department of School of Law and Human Rights under Faculty of Law.

Table 1. The Field of Sciences and Academic Degree at UIN Sunan Gunung Djati Bandung

No	The Field of Sciences	Academic Degree
1	Religious Studies	
	a. Quranic Sciences	B.A.
	b. Hadith Sciences	B.A.
	c. Comparative of Religious Studies	B.A.
	d. Islamic History	B.A.
	e. Arabic Language and Art	B.A.
	f. Islamic Propagation	B.A.
	g. Islamic Philosophy	B.A.
	h. Islamic Sufistic and Psychoteraphy	B.A.
	i. Islamic Education	B.Ed.
2	Social Sciences	
	a. Management	B.E.
	b. Accounting	B.E.
	c. Islamic Financial Management	B.E.
	d. Islamic Accounting	B.E.
	e. Sociology	B.A.
	f. Politics	B.A.
	g. Public Administration	B.A.
	h. Psychology	B.Psi.
	i. Communication	B.Com.
3	Natural Sciences	
	a. Mathematics	B.Sc.
	b. Biology	B.Sc.
	c. Physics	B.Sc.
	d. Chemical	B.Sc.
	e. Medicine and Health	B.Sc.
	f. Nursing and Midwifery	B.Sc.
	g. Pharmacy	B.Sc.
4	Scientific Sciences	
	a. Electronical Engineering	B.Sc.
	b. Industrial Engineering	B.Sc.
	c. Informatical Engineering	B.Sc.
	d. Agricultural Engeeneering	B.Sc.
	e. Civil Engineering	B.Sc.
5	Humanioral Sciences	
	a. Linguistics	B.A.
	b. Philosophy	B.A.
	c. Anthropology	B.A.
	d. Humanity	B.A.
	e. History	B.A.
	f. Arts	B.A.
	g. Legal Studies	L.LB.
	h. Islamic Economic Law	L.LB.
	i. Islamic Criminal Law	L.LB.
	j. Islamic Family Law	L.LB.
	k. Islamic Political Law	L.LB.
	l. Islamic Comparative of Law	L.LB.

In addition, there will be found various obstacles in the process of learning process at UIN Sunan Gunung Djati Bandung such as: first, internal obstacle is UIN needs to be equipped with adequate infrastructure and superstructure supporting academic activities, so that its vision and mission can be realized in accordance with the existing academic culture and social environment; second, external constraints are the need to develop a positive form of interaction with other agencies that can be invited to work together to optimize the achievement of UIN goals as a whole.

To solve these obstacles, UIN Sunan Gunung Djati Bandung has done several strategies such as empowering partnerships programs with other institutions domestically and abroad to support the implementation of academic activities. More clearly, link and cooperation are very useful for the development and integration of Islamic studies and science. Furthermore, these are also oriented to prepare the students and graduates to have sufficient scientific quality and skills, and also to have good morals and attitude. To

realize this expectation, Najib, Setiadi, Yusup, & Irfan (2008) explained that UIN Sunan Gunung Djati Bandung has developed the application of INQF and NSHE patterns through the following objectives:

- a. Developing the curriculum system and learning process based on competencies that contain academic competencies and life skills through the combination between theoretical and practical elements based on reality and felt needs in accordance with the dynamics of life in society;
- b. Improving academic quality in the process of scientific development through a learning process that is not only associated with output specifications, but also with an effective, efficient, productive, accountable, and adaptive learning process with changes in order to achieve academic atmosphere at UIN Sunan Gunung Djati Bandung environment;
- c. Improving the students' intellectual, emotional, and spiritual abilities to realize academic excellence, creed stability, noble and independent morals so as to foster student awareness as a Muslim, citizen, and global citizen in line of education for nation and global citizenship;
- d. Developing adequate educational facilities and infrastructure to support the implementation of academic activities and the improvement of students' talents and interests.

To aim the above objectives, various curriculum development efforts have been carried out, such as: first, enhancing the existing curriculum and learning process evaluations by carrying out regular workshops to improve the curriculum based on revelation guiding sciences towards research university; second, from the workshop, the number of recommendations were made to develop an integrated curriculum model in the philosophical, methodological, material, and strategy levels. The new curriculum and learning design was compiled reflects three things: (a) informative, i.e. a discipline that needs to be enriched with various information by disciplines of other sciences; (b) confirmative, i.e. the developed disciplines should be built on the basis of a strong theory and obtain confirmation from other sciences; (c) corrective, i.e. a theory of science needs to be confronted with religious knowledge or vice versa to be used as material for correction between one another. The rest of the curriculum also illustrates similarization or suitability so that they can strengthen each other between certain fields of science with other fields of science.

The elaboration of the curriculum workshop is the preparation of the syllabus and semester learning plan of each courses that is presented in general and Islamic studies programs that reflect the application of an integral and holistic scientific epistemological design based on the paradigm of revelation guides science. Moreover, the evaluation of curriculum and learning process are also conducted by faculties and study programs in accordance with the demands and needs in the development of scientific and technological progress. The results of the assessment, evaluation and curriculum development, came into force in the academic from year 2005 to now.

The Impact of the Integration of Islamic Learning and Science through Virtual Mechatronics Approach to Student Learning Outcomes

Generally the virtual mechatronics approach is used in the learning of applied science such as in mathematics, biology, physics, chemistry, electrical engineering, informatics engineering, civil engineering, agricultural technology, robotics, etc. (Silva, 2005). However, this approach also seems to be used in religious studies in certain study programs that require teaching tools, such as those conducted by lecturers at the Department of Physics Education at Faculty of Education and Teaching, UIN Sunan Gunung Djati Bandung, West Java, Indonesia.

The learning plan is prepared in one semester which includes 16 meetings that formulate a theoretical and practical approaches with an average credit weight of 3 credits per course, 24 credits per semester, a minimum total of 144 credits and a maximum of 160 credits during the study period, including the examination of undergraduate research thesis qualifications and presentations. Learning materials and sub-materials are arranged systematically based on the consideration of time, the availability of teaching materials, the completeness of learning facilities and infrastructures, and the number of students, especially methods, approaches, strategies, techniques, and evaluation of learning process (Priatna, 2014).

The result of empirical research shows that the lecturers teach physics to students with a various approaches, one of which is using a virtual mechatronics approach. This approach is applied simply in learning process (Onwubolu, 2005). In the beginning stages of learning process, the students are usually given a theoretical description of certain subject matter, for example the lecturer explains the conceptual framework of the change of liquid gas to freeze caused by climate change. Furthermore, students are given an independent



Figure 2. Simulation Room Model for Practicing Virtual Mechatronics Approach

task to compile an essay about the review of lecture material that has been delivered by the lecturer (Rankers, 1997).

In the second stage, the lecturer presented with power point shows about some concrete examples of the change of liquefied gas to freeze through various teaching aids, such as showing films, videos, photos, and simulations with various physical teaching tools (Priatna, 2014). At this stage, the lecturer also divides students into several small groups and gives them group assignments to conduct mini-research on various objects in physics. For example, they are researching sources of clean water that can be used for ablution, bathing, and drinking in accordance with Islamic religious values. The results of the field research are then compiled into a mini research report and presented in class by each group (Suhendi, Mulhayatillah, Anjani, Ramdani, & Ardiansyah, 2018).

In the third stage, the lecturer provides a final evaluation and assessment, where the assessment is not only related to the ability of the students to know, understand, and simulate learning outcomes with a virtual mechatronics approach, but also to what extent they choose research objectives that integrate the disciplines of religion studies and sciences in the frame of revelation guides science. In some cases, some students have no difficulties in doing like its learning activities because they have already had the basic abilities of physics when studying at the secondary level (Senior High School). But some of them found the difficulties in learning process because they do not have the basic skills and also less skilled in using teaching tools.

The result of this study indicates that 67% of 320 active students at the Department of Physics Education, Faculty of Education and Teaching, UIN Sunan Gunung Djati Bandung succeeded in exceeding the minimum learning outcomes criteria, i.e. they graduated with an average cumulative achievement index of 3.25 of 4.00. These results are of course not optimal because UIN Sunan Gunung Djati Bandung still applies triple standards, that is, each graduate must have also passed in memorizing the Quranic Surah and Verses with a minimum 3 of 30 Juz, passed the Arabic TOEFA test with 400 score, and also passed the English TOEFL test with 450 score, before they took the final exam. The final exam of study period is undergraduate thesis presentation. That is the main challenge that is actually faced by the lecturers and students as well as the decision makers and stakeholders of UIN Sunan Gunung Djati Bandung.

Based on the above explanation, in general it can be said that the prospectus of UIN Sunan Gunung Djati Bandung will be able to run well and smoothly if the integration of religious studies and science in the frame of revelation guides science to be “a new spirit” for the curriculum system and academic atmosphere. However, there would be found the number of challenges and obstacles that hindered the development of UIN Sunan Gunung Djati Bandung in the future. Emphasizely, it must be supported by the entire academic community, government, and society as a whole. This hope is the main goals of UIN Sunan Gunung Djati Bandung that should be realized in the future to be in accordance with the expectations of its institution as the center of academic excellence and world class-university.

CONCLUSION

In closing this paper, it can be concluded that the scientific paradigm in the form of integration between Islamic learning and science at UIN Sunan Gunung Djati Bandung is not only implicated to the changes of institutional status, faculties, study programs, but also fundamentally impacted to redesigning curriculum system, learning process, and learning outcomes of the graduates. This research shows that 67% of 320 active students at the Department of Physics Education, Faculty of Education and Teaching, UIN Sunan Gunung Djati Bandung are evidently passed and succeeded in exceeding the minimum learning outcomes criteria, i.e. they graduated with an average cumulative achievement index of 3.25 of 4.00. It means that the analogue of “wheel philosophy” as a symbol of scientific dynamics as well as “a new spirit” for the development of sciences impacted to the learning outcomes and learning objectives. Moreover, the rotation of the knowledge wheel on its axis that follows space and time is a demand and need to be achieved by UIN Sunan Gunung Djati Bandung in the future towards a research and world-class university that has a special reputation on a regional, national, and international scale as well as the center of academic excellence even though it not really easy to be realized.

Disclosure statement

No potential conflict of interest was reported by the authors.

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REFERENCES

- Abdullah, A. (2006). *Islamic Studies di Perguruan Tinggi: Pendekatan Integratif-Interkonektif* (pp. 404-405). Yogyakarta: Pustaka Pelajar.
- Adam, S. (2019). *An Introduction to Learning Outcomes a Consideration of the Nature, Function and Position of Learning Outcomes in the Creation of the European Higher Education Area*. Retrieved on 13 August 2019 from http://is.muni.cz/do/1499/metodika/rozvoj/kvalita/Adam_IH_LP.pdf
- Allan, J., & Clarke, K. (2007). Nurturing Supportive Learning Environments in Higher Education Through the Teaching of Study Skills: To Embed or Not to Embed? *International Journal of Teaching and Learning in Higher Education*, 19(1), 64-76.
- Athoillah, M. A. (2012). *Annual Report of Consortium Institution of UIN Sunan Gunung Djati Bandung*, Sunan Gunung Djati Press, 112.
- Athoillah, M. A. (2016). *Annual Report of Consortium Institution of UIN Sunan Gunung Djati Bandung*, Sunan Gunung Djati Press, 207.
- Athoillah, M. A., & Natsir, N. F. (2017). *The Scientific Paradigm of UIN Sunan Gunung Djati Bandung* (3rd Ed.), Sunan Gunung Djati Press, 7-11.
- Berryman, S. E. (2010). *Designing Effective Learning Environments: Cognitive Apprenticeship Models*. Institute on Education and the Economy, New York, Teachers College Columbia University, 5-7.
- Bradley, D. A., Loader, A. J., Burd, N. C., & Dawson, D. (1993). *Mechatronics, Electronics in Products and Processes* (pp. 213-215). London: Chapman and Hall Verlag.
- Cetinkunt, S. (2007). *Mechatronics* (pp. 245-249). New York: John Wiley & Sons Inc.
- De Silva, C. W. (2005). *Mechatronics: An Integrated Approach* (pp. 13-15). New York: CRC Press. <https://doi.org/10.1201/b12787>
- Dick, W., Carey, L., & Carey, J. O. (2004). *The Systematic Design of Instruction* (pp. 189-190). New York: Harper Collion Publishers.
- Echols, J. M., & Shadzily, H. (2003). *Kamus Inggris-Indonesia* (pp. 326). Jakarta: Gramedia Pustaka Utama.
- Frelberg, H. J., & Driscoll, A. (2000). *Universal Teaching Strategies* (3rd Ed., pp. 62). Boston: Allyn & Bacon.
- Gerlach, V. S., & Ely, D. P. (1980). *Teaching and Media: A Systematic Approach* (pp. 1-3). New Jersey: Prentice Hall.
- Karnopp, D. C., Margolis, D. L., & Rosenberg, R. C. (2006). *System Dynamics: Modeling and Simulation of Mechatronic Systems* (4th Ed., pp. 193-195). Wiley.

- Mechanical and Mechatronics Engineering (MMED). (2011). What is Mechatronics Engineering? In *Prospective Student Information*, France, University of Waterloo, retrieved 19th August 2019.
- Ministry of Education and Culture Republic of Indonesia. (2014). *MEC Regulations Number 49 of 2014 on National Standards of Higher Education* (pp. 4-7). Jakarta: MEC.
- Mustopo, A. (2017). Integrasi Agama dan Ilmu Pengetahuan. *Journal Al-Afkar*, V(2), 82.
- Najib, M., Setiadi, A. D., Yusup, D. K., & Irfan, M. (2008). *UIN Sunan Gunung Djati Bandung towards Research University* (1st Ed., pp. 3-5). Bandung: Sunan Gunung Djati Press.
- Nasution, K. (2017). Berpikir Rasional-Ilmiah dan Pendekatan Interdisipliner dan Multidisipliner dalam Studi Hukum Keluarga Islam. *Journal Al-Ahwal*, 10(1), 19-20. <https://doi.org/10.14421/ahwal.2017.10102>
- Natsir, N. F. (2005). *The Scientific Paradigm of UIN Sunan Gunung Djati* (pp. 1-2). Bandung: Sunan Gunung Djati Press.
- Newman, L., & Makmun, A. S. (2003). *Psikologi Pendidikan* (pp. 17-19). Bandung: Remaja Rosda Karya. <https://doi.org/10.20885/psikologika.vol8.iss16.art3>
- Nutaro, J. J. (2019). *Building Software for Simulation: Theory and Algorithms, with Applications in C++*. Wiley. Retrieved on 13 August 2019 from <http://wikipedia.com/virtual/mechatronics>
- Onwubolu, G. C. (2005). *Mechatronics: Principles and Application* (pp. 122-126). Amsterdam, Butterworth-Heinemann.
- Partanto, P. A., & Al-Barry, M. D. (1994). *Kamus Ilmiah Populer*, Surabaya, Arkola, 264.
- Pengembang SPMI, T. (2019). *Standar Nasional Pendidikan Tinggi* (pp. 16-20). Jakarta: Ministry of Research, Technology, and Higher Education, Republic of Indonesia.
- Praja, J. S., & Natsir, N. F. (2011). *The Scientific Paradigm of UIN Sunan Gunung Djati Bandung* (2nd Ed. Pp. 15-17). Sunan Gunung Djati Press.
- Priatna, T. (2007). *A Handbook of Physics Learning through Mechatronics Approach at Faculty of Education and Teaching* (pp. 3-7). Bandung: Sunan Gunung Djati Press.
- Rankers, A. M. (1997). *Machine Dynamics in Mechatronics System* (pp. 28-35). Enschede: University of Twente.
- Roswanto, A. (2007). *Mengukir Prestasi di Jalur Khusus: Protret Lulusan Pondok Pesantren di Indonesia* (pp. 40-41). Yogyakarta, Pontren Kemenag.
- Setiadi, A. D. (2010). *The Profile of UIN Sunan Gunung Djati Bandung* (1st Ed., pp. 1-3). Bandung: Sunan Gunung Djati Press.
- Suhendi, H. Y., Mulhayatillah, D., Anjani, R., Ramdani, M. A., & Ardiansyah, R. (2018). A Virtual Laboratory of Heat Transfer Concept in Microscopic Form. *Proceeding 3rd Annual Applied Sciences and Engineering Conference (AASEC)* (pp. 1-6), Bandung, IOP Publishing. <https://doi.org/10.1088/1757-899X/434/1/012288>
- Tafsir, A., & Natsir, N. F. (2011). *The Scientific Paradigm of UIN Sunan Gunung Djati* (2nd Ed., pp. 49-50). Bandung: Sunan Gunung Djati Press.
- Vesto. (2019). *An Overview Learning through Virtual Mechatronics Approach*. Retrieved on 13 August 2019 from <https://www.festo-didactic.com/int-en/highlights/turnkey-education-solutions/overview-learning-environments/virtual-mechatronics/?fbid=aW50LmVuLjU1Ny4xNy4xMC43NTI5LjQzNjM>
- Yusup, D. K. (2012). *The Profile of UIN Sunan Gunung Djati Bandung* (2nd Ed., pp. 1-3). Bandung: Sunan Gunung Djati Press.

