Digital Based Education Through Econophysical Modeling

Iiz Izmuddin¹*, Pandapotan Harahap², Awaluddin³, Widya Syafitri⁴, M. Imamuddin⁵

¹,³,⁴,⁵Institut Agama Islam Negeri (IAIN) Bukittinggi, Indonesia
²Universitas Islam Negeri (UIN) Sumatera Utara, Indonesia

*iizmuddin@gmail.com

Abstract. The purpose of this article is to describe the integration model of social and physical science into digital-based learning. Indonesia's education system currently uses digital technology in the education process so that the absorption and teaching methods will be more easily understood. The use of Econophysical modeling in digital learning can be developed in the form of recording all transaction networks carried out by consumers using physics modeling in applied physics usage. Then every track record of transactions with physics modeling will be linked to Hardware, Software, and Contents Development. So that the data process will be formed very quickly from every existing transaction. Then all existing data will be collected in big data analysis which then becomes digital-based econophysical modeling. Its application in education by teachers and lecturers is administratively contained in the lesson plan and syllabus while in the learning process linked with Hardware, Software, Contents Development for the formation of modeling in learning econophysical courses.

Keywords: Econophysical, digital, education, Modeling, integration

1. Introduction

The development of technology toward all-digital is now increasingly rapid. In this digital era, humans in general have a new lifestyle that cannot be separated from all-electronic devices. Technology becomes a tool that is able to help most human needs. Technology has been used by humans to make it easier to do any task and job. The important role of technology is what brought human civilization into the digital age.

The digital age has brought various good changes as a positive impact that can be used as well as possible. But at the same time, the digital era also brought many negative impacts, thus becoming a new challenge in human life in this digital era. Challenges in the digital era have also entered into various fields such as politics, economics, social culture, defense, security, and information technology itself.[1]

The digital age was intuitive with the advent of digital, internet networks especially computer information technology. New media in the digital era have characteristics that can be manipulated, are networked or internet. The mass media turned to new media or the internet because there was a cultural shift in the delivery of information. The ability of this digital age media eases people to receive information faster. With the internet media making mass media flock to the bow. The more sophisticated digital technology today is making major changes to the world; the birth of various kinds of increasingly advanced digital technology has emerged. Various groups have been facilitated in
accessing information through many ways, and can enjoy the facilities of digital technology freely and in a controlled manner [2].

The digital age also makes people's privacy seem lost. Personal data recorded in a computer makes it easy for internet dwellers to be tracked, both in terms of surfing habits or hobbies. The digital age is not a matter of being prepared or not and is not an option but is a consequence. Technology will continue to move like ocean currents that continue to run in the midst of human life. Then there is no other choice except to master and control technology properly and correctly in order to provide maximum benefits. Economic research based on the concept of science, especially physics is increasingly being carried out so that the demands of quantitative analysis on the financial system are increasingly high. The depiction of physical phenomena in economics in this case is called econophysics. Econophysics is an idea or method and model in statistical physics and complexity systems to analyze data from economic phenomena. Physics model has a lot of modeling but not balanced with data, in contrast to economics that has a lot of data but has a little modeling [3]. Economic data have quantitative analysis, such as inflation analysis, fiscal policy and monetary policy, all of which require a derivative to a physics-analyzed model. So that will build an understanding and strengthening of the scientific integration of economics and physics with a statistical approach as the modeling bridge. Physical reasoning will provide strength in conducting analyzes related to macro or micro instruments.

During this time, many people comprehend that physics and economics are two disciplines that cannot possibly being together. Both of them even seem to be opposite each other. This opinion is based more on the view that physics belongs to the exact science family while economics is under the social science family. The two clusters are understood to have differences on the ontological level. The two epistemologies are also seen as not the same. This difference then makes some experts in both sciences state that physics is impossible to close to economics. Even Mubyarto, UGM economist, established that if the economy had to join with other sciences, then the reconciliation had to be done not with physics, but with sociology and anthropology [4].

In the aspect of the history of econophysics, it was conceived in 1997, meaning that the realm of human science has increased by attempting to carry out views and ideas about econophysics by the European Physical Society with the heading International Applications of Physics in Financial Analysis in Dublin Ireland and continued in Liège the following year, stated that several early generation books that examined these concepts included An Introduction to Econophysics by Mantegna and Stanley in 2000, Theory of Financial Risk: From Statistical Physics to Risk Management by Bouchaud and Potters in 2000 and An Introduction to High Frequency Finance by Dacorragna et al in 2001 [4].

The use of digital technology which is very fast growing is in the business field. Market participants desperately need access to information that is fast, broad, large and supports their transaction activities. Now almost all lines of business cannot be separated from digital technology in its marketing. Considering that education is one of the business sectors, learning has begun to be changed from conventional to digital based. Educational technology experts are very concerned in integrating information and communication technology in facilitating, accelerating and achieving learning and education goals. At the beginning of its application, the use of digital technology in schools is the seriousness of policy makers to realize a computer laboratory. Furthermore, the policy becomes bigger when the subject of information and communication technology (ICT) becomes one of the subjects in secondary schools. Even now elementary schools have made ICTs part of the curriculum, both core and additional [5].

There was a gap in high school alumni before the 2013 curriculum that had experienced ICT learning compared to later (2015 to 2018). Although ICT subjects may be re-included in the curriculum, but because they are not core subjects, some classes of students do not have the opportunity to complete ICT material in full. At a higher level, the use of digital technology is an obligation for teachers, lecturers and students, such as portable computers, tablets and smartphones. Almost all students have portable computer and smartphones that greatly help their learning activities. Learning to use these devices is increasingly powerful with the integration of computers, telephones
and cameras and the connection of all these components with the internet. If previously this information and communication technology was held by people working in the computer department (and its derivatives), now the ability to use it becomes an obligation for all students, including teachers and lecturers. At present, technological literacy (including digital) is a condition for a person to be said to be literate based on 6 existing literacy dimensions (read and write, numeracy, science, digital, financial as well as culture and citizenship).

This close interaction between physics and economics makes De Liso and Filatrella (2001) and Stauer (2000) state emphatically that econophysics is not a new domain of science. Referring to these two opinions, then the assumption of Kebamoto (2002) and Mart (2001) that econophysiology is a new idea of physics or a new field of research in physics can be judged as an incorrect assumption. Also at this level, Mubyarto's (2002) suspicion of econophysics urged LIPI and AIPI to seriously discuss econophysics.

To develop and apply econophysics into digital learning today is a necessity because the development of the digital service-based economy is currently growing rapidly. Almost all elements of society use digital services to meet their needs. The world is borderless. That is, humans can interact with each other from one place to another without having to meet. Facebook, whatsapp, instagram, links are some of the digital service applications that are often used by the public. The use of digital services certainly have weaknesses and strengths. However, is there a way to minimize these weaknesses? Digital service users are expected to become smart and wise digital service users. That is, they use digital services as needed by observing the Law on Information and Technology (IT Law) in force in Indonesia. The use of digital services has a positive effect on economic development in society. People are racing to earn a fortune by using digital services to transact. The use of digital services in the economic world is what is called the digital economy. Digital economy includes the existence of online trade (e-commerce), e-travel, and financial technology (fintech).[6] The main activity in the digital economy is the existence of online transactions between economic agents and online payments. The activity is part of the material in economic learning at the Senior High School level. Transaction is a sale and purchase agreement. Economic actors include producer households, consumer households, government households, and overseas communities. Online payments are payment of financial institutions that provide online payment services such as ATMs, Debit Cards, Credit Cards, and e-money. This digital diera has made it easy to transfer knowledge through digital technology. Technology in the learning process one of which can be used as a learning medium. The use of instructional media in the orientation phase of teaching will greatly assist the effectiveness of the learning process and delivery of messages and content of the lesson at that time. At this time it is time for universities and education to integrate science into digital-based learning so that it will provide knowledge and ease in obtaining information. The world of education today is already partly integrated with digital systems in terms of learning and is not yet known as integrated learning between exact science and social science into digital learning. This article tries to explain and provide modeling related to the integration of social science and exact science into digital learning so that education experts and education observers can provide learning in econophysics courses integrated with digital.

2. Methodology

The approach used in writing this paper is the literature study. This method includes Econophysics and digital education data collection stage (the data used comes from the literature relating to the issues discussed), data analysis (data collected are selected then contextualized with the topic in a logical and systematic manner), compilation and drawing conclusions (information collected obtained compiled based on the results of studies conducted so that a series of paragraphs that are interrelated between one another in accordance with the topics discussed then proceed with drawing conclusions after referring to the formulation of the problem, the purpose of writing and discussion / analysis). Submission of ideas is done through narrative paragraphs in a descriptive argumentative manner. The presentation of the model is done schematically and the development of empirical models
for further research as novelty on the concepts developed. The econophysical approach taken in answering the raised problems is theoretical-qualitative and focuses on Bernoulli's Theory related to physics which is integrated with economics.

3. Result and Discussion

A. Econophysical Modeling

To get a model of econophysics, it takes a lot of data from economic transactions, for example a phenomenon when someone is heading home (from work), then there is a price drop on the roadside. When stopping and trying to pay attention, especially until the transaction of this phenomenon can not be explained by economists, but physicists can explain as a phenomenon of water channels (pipes) that leak for example. Then Bernoulli's Law of fluid dynamics is used for his explanation.[7] Furthermore, for digital engineering, the data recorded in each transaction is generally collected in the company's server if done digitally. But even manual transaction data can basically also, only the input is slow. If the community (economic actors) are accustomed to using their cellphones or smartphones in:

- searching
- buying
- paying
- accepting shipments
- sending
- moving locations (like GoJek) and others,

then all these track records can be analyzed by special software. If it is too complex and in the form of big data (analysis), then Artificial Intelligent technology is used in processing the data. This technology is an advanced application of computer technology and robotics. From the simple Big Data Analysis, it can be seen the connection between each data, so it can be concluded, that:

- A is so many years old
- A is always shopping for products such as (computer accessories)
- A always goes through certain roads / routes
- A uses Bank A, B, C transaction services
- A is also always looking for certain keywords, such as Bitcoin, Investment etc.

The results going forward, the A will get information (advertisements and others), whether to an email / sms or a notification appears on his cell phone related to the offer and others.[8]

B. Econophysical in Business Transaction

1. Stocks

Lately, Big Data Analysis technology with Artificially Intelligent has also been applied to online trading such as commodities and non-commodities on the internet (forex, stocks and others) that are real time. When the market (stocks or other) is opened, there will be an automatic interaction between buyers and sellers. Considering that the market is open and online 24 hours a day, traders from all over the world can make transactions from anywhere and at any time.

With global regulation, this interaction can be assumed as two separate gases (CO and CO2) which are separated in each tube, but connected to a pipe. Once the cylinder tap is opened, the gas molecules will interact with each other. The interaction above can be seen as a buyer and seller in an already opened market. If the types of gases are different and mutually binding and this interaction is strong, new gas bonds will form. This bond in physics is a new form of 2 different gases. Physics equations (formulas) can be used to determine the interactions, even models can also be made.
Another example, if there is a tube filled with gas, then the valve is opened (for example kitchen gas), then the kitchen room will smell. Then over time the gas floats and interacts with the air in the room until finally the pressure in the tube runs out or is very small. The interaction of kitchen gas with indoor air can also be seen as the entry of market participants (agents) into the larger environment and influence it.

If the room is too big, the results of the interaction will be slow and not produce results. Conversely, if the interaction is in a small and closed room, it can make a great interaction; it can even be in the form of an explosion (a big pressure but a small space). This interaction of gas and air molecules can be seen as an economic phenomenon that is out of the ordinary, such as stone rings, anturium flowers, fish that once echoed. The phenomenon is, quickly, momentarily, booming and finally returning to normal.[9]

2. Analyzing Stalled Investment

There are many networking businesses in the name of MLM and Investment, even though they are under the guise of a bulging business. In its Fatwa, MUI has provided sufficiently detailed rules related to a tiered marketing system so that it can be run according to Islamic sharia. So companies that run their business do not violate Islamic regulations.[10] Although it cannot be controlled entirely, the networking businesses can be analyzed using Econophysics. One of them is the Phenomenon of Reaction Phenomenon (Nuclear Fission) which is described as a series of fissioning of nuclei into childless children, in mathematics in the form of binary ranks or more.[11]

One of the well-known as a bulging investment is Ponzi, which is a product not comparable to the money deposited, the results of at least 50% of capital and a short period of time (eg 3 weeks or 2 months). The first person to do this was Ponzi in the United States, who received an old paid member from a new member who registered, and so on until a registrant's saturation point was obtained.

![Figure 1. The schematic cleavage scheme becomes mild in a chain fission reaction.](image)

The Fission reaction is known in Nuclear Physics, where the nucleus of heavy atoms (for example Uranium 238) can be split with heavy particles such as neutrons. This cleavage results in lighter nuclei (for example Krypton 90 and Barion 144). If this reaction is not controlled, then the division will occur in a chain until the number of heavy nuclei at the beginning runs out in a short time with enormous energy, for example an atomic bomb.[12]

Fast-growing business forms such as the Ponzi scheme under the guise of investment fulfill the form of uncontrolled core cleavage reaction as illustrated above. The amount of energy (money coming in) must be limited, unless old migrants reinvest their funds. But the amount is still limited.
From the division scheme into 2 parts, it can be predicted when the business collapsed. Characteristics, the product is not clear (not comparable to the money register), a large sponsor / recruitment bonus (more than 15%), fast growing, excited and closed.

However, if this reaction can be controlled, then high heat can be generated which can be used for very useful purposes such as nuclear power plants. Control referred to in business like this is in accordance with the rules that exist in the DSN MUI. Investment-based businesses that have real products, realistic bonuses will surely be long-lasting and successful.

![diagram](image)

**Figure 2.** The cleavage scheme of the heavy nuclei becomes a mild controlled fission reaction.[13]

### C. Econophysical Modeling in Digital Education

Seeing econophysics involved in big data and modeling, as well as processing data that must be fast, the basis of learning physics and digital education is needed. Students and university students must be able to use physical concepts to observe the symptoms of economic transactions (various fields including finance and management). Furthermore, the use of digital technology which includes animation and applications (general / special) must be used to facilitate learning.

It is very difficult to carry out learning with complex reason without the help of applications for students. The application of digital-based education that is appropriate to greatly assist the success of learning achievement. Very closely in our memories, how difficult it is to use Excel applications / programs in learning Statistics. But the existence of SPSS and others greatly facilitates data analysis, although the basics of statistical science must still be understood. Unlike the SPSS that has been determined based on economic concepts and statistics that existed before, modeling in Econophysics is more complex and different. For this reason, the use of digital technology in learning, especially economics & physics, is needed. So to strengthen econophysical learning in tertiary institutions or even in middle schools, a model flow is made in the development of the integration of economics and physics into digital-based education as seen in the section below.
Figure 3. A Model flow is Made in the Development of the Integration of Economics and Physics

The picture above is a form of economic and physical relations and digital technology (up to Artificial Intelligent / AI) that is able to process Big Data Analysis from digital data. Meanwhile from here digital based education can be involved with the scope of: Digital Data / Records, Digital Economy and Digital Content. For hardware and software development currently boils down to blockchain technology. Transaction data made by physics modelling will be linked to analysis of big data as a new model of conclusions in digital-based education. Then the lecturer as a tutor in learning econophysics will reduce the econophysical modeling into the syllabus and lesson plan for learning in the semester. More details will be seen in table 1 relating to econophysical derivation from the scientific aspect to the learning stage by lecturers and teachers.

Table 1. Derivation of Econophysical Modeling in Digital-based Learning

| No | Science | Branches                  | Detail          | Derivation       | Focus                                                                 |
|----|---------|---------------------------|-----------------|------------------|----------------------------------------------------------------------|
| 1  | Physics | Theory of Physics         | Computer        | Hardware         | The History & Development of technology: processor, memory, media, transmission, etc. |
|    |         | Applied Physics           | Electronic      |                  | The basic and concept of binary for computer                         |
|    |         | Physic instrument         |                 |                  |                                                                      |
|    |         | Physic Material           |                 |                  |                                                                      |
| 2 | Economic | monetary Economy | Money concept | processor |
|  |  | Public Economy | Market behavior | |
|  |  | Industry Economy |  | |
|  |  | International Economy |  | |
|  |  | Economic |  | |
|  |  | Regional | Natural | |
|  |  | EconomyHum | Resources economy | Islamic Economic | The economic concept is in accordance with Islamic provisions and its development |

| 3 | Econophysics | Concept | Collection of economic data | Test phenomena: such as customer behavior |
|  |  | Model | Adjustment of existing models in physics & economics | New model creation & development |
|  |  | Complex distribution system | Artificial Intelligent & Big Data analysis its decision and model and development |

| 4 | Digital based education | Character: | Main and supporting technological developments |
|  | Sinergy between educator and ICT: | student-centred, multimedia, collaboration, information changing, critical thinking. | Note. From semi automatic to automatic |
|  | Educational psychology | activity: SCORM form (Sharable, Content, Object, Reference, Model) | Computer applications / programs that support general & special purpose teacher and lecturer education |
|  | Education technology | Effective: Apperception, motivation, activity, correlation, repeating, | Note. From the same direction / drill, interactive, to what can be developed by teachers / lecturers & students |
|  | Economy/ industry | Content | Content processing by educators for the development of student competencies |
|  | Multimedia |  | Note. In the future, some teacher and lecturer roles can be replaced, such as using VR, Robotic, can be |
The derivative process will then be developed by lecturers into lesson plans and syllabi that are filled with econophysics courses with a digital technology approach.

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