

## Development of Physics Learning Materials STEM-Local Wisdom Oriented to Improving Students' Critical Thinking Skills

Nugraheni Ayu Agustina ✉, Raden Wakhid Akhdinirwanto, Siska Desy Fatmaryanti

Universitas Muhammadiyah Purworejo

Jl. KH.A. Dahlan 3 Purworejo, Jawa Tengah, 54111, Indonesia

[nugraheniaa1707@gmail.com](mailto:nugraheniaa1707@gmail.com) ✉ | DOI : <https://doi.org/10.37729/jips.v3i2.1482> |

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**Abstract** – Research on the implementation of STEM-oriented physics learning and local wisdom has been carried out to determine the feasibility of STEM-oriented physics learning and local wisdom to improve students' critical thinking skills. This study uses the 4D development method, namely Define, Design, Develop, and Disseminate. The subjects of this study were students of class X MIPA at SMA Negeri 6 Purworejo for the academic year 2020/2021. The research data were obtained using interview methods, product validation, critical thinking skills validation, learning implementation validation, and student response questionnaires. The results of this study were obtained: (1) the validity of learning in terms of two expert validators got an average final score of 3.46 and 3.45 from material experts and media experts, so it can be said to be very valid and can be used in limited and broad tests. , (2) the results of the implementation of learning seen from the implementation sheet of learning are stated to be practical, and (3) the improvement of students' critical thinking skills seen from the pretest and posttest scores is always significantly increased and the N-gain is included in the medium category, and (4) getting participant responses positive students with good categories. Thus, it can be concluded that STEM-oriented physics learning and local wisdom are appropriate to be used to improve students' critical thinking skills.

**Keywords:** *STEM, Local wisdom, Learning materials, Critical thinking*

**Abstrak** – Penelitian implementasi pembelajaran fisika berorientasi STEM dan kearifan lokal telah dilakukan untuk mengetahui kelayakan pembelajaran fisika berorientasi STEM dan kearifan lokal dalam meningkatkan kemampuan berpikir kritis siswa. Penelitian ini menggunakan metode pengembangan 4D yaitu Define, Design, Develop, dan Disseminate. Subyek penelitian ini adalah siswa kelas X MIPA SMA Negeri 6 Purworejo tahun ajaran 2020/2021. Data penelitian diperoleh dengan menggunakan metode wawancara, validasi produk, validasi keterampilan berpikir kritis, validasi pelaksanaan pembelajaran, dan angket respon siswa. Hasil penelitian ini diperoleh: (1) validitas pembelajaran ditinjau dari dua validator ahli mendapatkan rata-rata skor akhir 3,46 dan 3,45 dari ahli materi dan ahli media, sehingga dapat dikatakan sangat valid dan dapat digunakan. dalam tes terbatas dan luas. (2) hasil pelaksanaan pembelajaran dilihat dari lembar pelaksanaan pembelajaran dinyatakan praktis, dan (3) peningkatan kemampuan berpikir kritis siswa dilihat dari nilai pretest dan posttest selalu meningkat secara signifikan dan nilai N -gain termasuk dalam kategori sedang, dan (4) mendapatkan respon peserta didik yang positif dengan kategori baik. Dengan demikian dapat disimpulkan bahwa pembelajaran fisika berorientasi STEM dan kearifan lokal tepat digunakan untuk meningkatkan kemampuan berpikir kritis siswa.



**Kata kunci:** *Bahan ajar, STEM, Kearifan lokal, Berpikir kritis*

## 1. Introduction

Natural science (IPA) is a subject that discusses the relationship between nature and mathematics, or it can be called science is a discovery of existing facts. Physics is one of the branches of science whose context is studying technological developments with natural sciences, the current rapid development in the field of technology is triggered by the many findings in the field of physics through electronic intermediaries that contain a lot of information with a very small size. In the 2013 curriculum, there are considerations of the importance of being taught physics, including (1) Providing provisions to students as a vehicle to grow thinking skills that are useful for solving problems in several physics lessons related to everyday life. (2) Preparing generations of Indonesian youth in the competence of attitudes, skills, and knowledge to develop science and technology [1]. To support the realization of physics learning objectives in the 2013 curriculum, appropriate learning models are needed, one of which is the Science, Technology, Engineering, and Mathematical (STEM) learning model.

STEM or which stands for Science, Technology, Engineering, and Mathematics is one of the learning methods that provide greater relevance to subjects in the classroom because this method directly addresses the real world and problems of students and society. The main things that are applied to the STEM method in learning are: First, each subject must be contextual. Second, every learning activity must be an inquiry, hands-on, and open-ended. Third, STEM itself is developed through an engineering design process that requires students to be creative in creating, innovating, and making breakthroughs. Fourth, STEM applies science and mathematics creatively, effectively, and contextually. Fifth, allows students to give the same answer and correct failures in the subject. Sixth, can build the ability to cooperate [2].

STEM-based learning requires students to become innovators (reformers), problem solvers, and inventors who are aware of technology and can think logically and critically. In learning that applies the STEM approach, it uses a formative and summative assessment system in the form of a written test for knowledge competency assessment and a work test (practicum) for skills competency assessment [3]. In today's modern era, students are expected to have critical thinking skills to be able to face global competition. But in reality, most of the students' abilities are still at the level of understanding concepts and applying concepts that have been experienced before, while students' critical thinking skills are still relatively low [4].

Physics learning at the high school level at this time still emphasizes the concepts contained in existing books regardless of the surrounding environment and using the lecture method is still the most dominant choice in every lesson. This makes learning monotonous and less varied so that students feel bored in class [5]. The implementation of physics learning should be able to take advantage of the surrounding environment as a source of learning for students. Learning physics by utilizing the surrounding environment is very important in supporting the learning process of students because it can involve cognitive, affective, and psychomotor aspects.

Learning by utilizing the surrounding environment not only gains knowledge but can gain the ability to solve high school physics problems for students from the surrounding environment. Direct involvement of students with nature during the learning process will provide more optimal learning experiences and results. In addition, utilizing the environment in the learning process can instill a sense of love for the natural surroundings [6].

Natural phenomena that occur in the environment are a source of learning in Physics learning, to achieve existing learning objectives, educators are required to be able to create contextual learning strategies that provide varied activities and can relate the concepts being studied with events that are often found on the surrounding environment. One strategy that teachers can use in learning activities that can be developed is based on local wisdom to improve the ability of students to solve high school physics problems by utilizing the potential of the existing environment and culture as a source of learning in managing community resources [7]. Local wisdom contains the potential values needed to realize a more meaningful and relevant education with the socio-cultural situation [8]. Science learning is expected to be able to grow the character of students who are more appreciative of the various existing cultures and strive

to preserve that culture [9]. The scope of local wisdom is very diverse and unlimited in space one of them is a traditional game. Traditional games have become a wealth of Indonesian culture. Traditional games can be used in the world of education, one of which is through traditional game-oriented learning that can be adapted to several subjects according to the curriculum.

Traditional games are games that contain valuable cultural elements because traditional games have a great influence on psychological development, character, and social continuity [10]. The use of traditional games to achieve learning indicators must be designed in such a way that it is by the learning material [10]. Traditional games are formed from cohesiveness, the interaction between people which is a form of togetherness [11].

STEM learning has five stages in its implementation in the classroom, namely observe, new ideas, innovation, creativity, and society [12]. (1) Observation, in this stage students, are motivated to observe various phenomena of traditional games related to the concept of science and the material provided and the teacher provides an overview of the exponential application in the fields of science, technology, engineering, and mathematics. (2) New ideas, in this stage students, observe and seek additional information about various phenomena or issues related to the topic of the subject being discussed, then students design new ideas. Students are asked to seek and seek new ideas from existing information, at this step students need analytical skills and think hard. (3) Innovation (Innovation), the innovation step of students is asked to describe the things that have been designed in the step of planning new ideas that can be applied in a tool. (4) Creativity, in this step, is the implementation of the results in the new idea step. (5) Value (society) is the last step taken by students in question is the value possessed by the ideas generated by students for actual social life.

The learning process of STEM-oriented Physics and local wisdom is focused on facts and phenomena about effort and energy. Facilities from local wisdom can be developed to support learning with a STEM approach. Based on the explanation of the problems above, researchers are interested in researching to implement STEM-oriented physics learning and local wisdom to improve students' critical thinking skills. Critical thinking is an activity through a way of thinking about ideas or ideas related to a given problem or concept [13]. Fisher argues that critical thinking is a skilled and active interpretation and evaluation of observation and communication, information, and argumentation [14]. Critical thinking can be interpreted as the ability of students to identify and formulate a problem, which includes and determines the core, finding similarities and differences, digging up relevant information and data, the ability to consider and assess so that they can distinguish facts and opinions, find assumptions, and draw reliable conclusions [15]. Critical thinking is the main goal in learning because, with adequate critical thinking skills, students can not only master the content in every learning activity but can also apply it in everyday life.

Critical thinking ability in Bloom's taxonomy is the classification of educational goals into three domains, namely the cognitive, affective, and psychomotor domains. The cognitive domain is related to reasoning or intelligence. The affective domain is related to taste. The psychomotor domain is related to psychomotor or physical movements related to the soul, in the cognitive domain, intellectual skills are divided into several levels, namely C1 to C6. Taxonomy of critical thinking abilities is clarified in Bloom's taxonomy, levels C1 to C6 in the cognitive domain as follows: 1) Knowledge (C1) about recalling learned information. 2) Understanding (C2) is about understanding the meaning of learning materials from various directions. 3) Application (C3) about applying knowledge to procedures in certain circumstances. 4) Analysis (C4) on understanding and identifying materials and concepts so that they are easy to understand. 5) Evaluation (C5) of the ability to assess based on criteria or standards. 6) Create (C6) involves the process of arranging elements into a coherent or functional whole [16].

In this research, the researcher refers to analysis (C4), evaluation (C5), and creating (C6). Indicators of critical thinking skills in Bloom's taxonomy [17] referred to by the researcher are: (1) Analysis (C4) consist of defferentiate (give a simple explanation) and organize (provide further explanation). (2) Evaluation (C5) consist of check (make a conclusion) and criticze (building basic skills). (3) Create (C6) consist of formulate (set a strategy and tactics) and produce (building a basic skills). Critical thinking is a high-level thinking process or mental activity that requires students to analyze, synthesize and evaluate and make decisions about what is believed so that they can solve a given problem.

## 2. Methods

This research was conducted using research and development (R&D) methods. R&D is a research method used to produce a particular product and test the effectiveness of that product. In this study, the product produced is a STEM-oriented Physics learning module and local wisdom which is expected to improve student's critical thinking skills [18]. The development process in this R&D study uses the Four-D Model (4D) development model. According to Trianto, the 4D model includes four stages, namely: (1) Define; (2) Design (Design); (3) Develop (Development); and (4) Disseminate (Dissemination).

The subjects of this study were students of class X MIPA at SMA Negeri 6 Purworejo for the academic year 2020/2021. The research data were obtained using interview methods, product validation, critical thinking skills validation, learning implementation validation, and student response questionnaires.

## 3. Results and Discussion

Understanding the material is one of the competencies that must be possessed by every student after participating in learning activities. Good learning is learning that can convey the relevance of learning materials with science, technology, knowledge, and mathematics. The purpose of learning physics is to improve students' thinking skills so that participants can support systematic, objective, and creative thinking, not only in the psychomotor and cognitive fields [19]. The application of STEM-oriented learning and local wisdom is expected to improve critical thinking skills. After the learning activities take place, students will be given problems to find out the students' responses to the application of the learning used.

The results of the pretest, it can be seen that each student before the learning process takes place already have prior knowledge. The initial knowledge possessed by students related to the concepts of work and energy is very diverse. For every physical concept related to work and energy, there are variations in the conception. This shows that every student enters the class not with a blank mind, but already has various ideas about a scientific concept. Profile of students' critical thinking skills can be seen in [Tabel 1](#).

**Tabel 1.** Critical Thinking Ability

Indicator	Area Test		N-gain	Category
	Pre-test	Post-test		
C4	9.2	27	0.58	Currently
C5	13	26	0.47	Currently
C6	10	26	0.51	Currently

[Table 1](#) shows that the average post-test score is higher than the pre-test score and the average N-gain score is in the high category. This shows that after STEM-oriented learning and local wisdom students experience an increase in critical thinking skills. The N-gain in [table 4.1](#) shows that the critical thinking ability test of students has increased after STEM-oriented learning and local wisdom are implemented. This means that it is rejected and accepted if the level of significance  $H_0H_1 < 0,05$  [20].

In terms of mastery learning, the KKM for class X MIPA 3 is 70. The percentage of students' completeness in the pretest is 0% and the post-test is 89%. This shows that there is an increase in student learning outcomes because the average learning outcome is higher than the KKM. So, classically students have exceeded the KKM determined by the school. The results of the study were then tested using the SPSS-assisted paired samples statistic method. The results of the calculation of paired samples statistics can be seen in [Tabel 2](#).

**Tabel 2.** Paired Samples Correlations

Data	N	Correlation	Sig.
Pretest & Posttest	36	.261	.124

The results of the paired sample correlations in **Tabel 2**, obtained a significance value (Sig. 0.124) and the correlation results from the pretest and posttest data of 0.261. The comparison value in this hypothesis test is the KKM value of 72. The results of the hypothesis test of learning outcomes can be seen in **Tabel 3**.

**Tabel 3.** Paired Samples Test

Paired Differences							
mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
			Lower	Upper			
-45,667	8.77985	1.46331	-48.63734	-42.69599	-31.208	35	.000

The data from this study were obtained from the pre-test scores of students' critical thinking skills on each indicator of critical thinking skills which included analyzing the concept of effort and energy through daily events and providing further explanations about the effort required in the limited test class, while the class was still low. medium area test. This is because students have not yet analyzed well. Problem number 2, for example, an experiment with a known mass, force, and past time is asked to order the amount of work required from least to greatest. Students are asked to analyze the question. On average, students from both classes only answered the formula, students could not analyze and explain business through everyday events. This happens because the students' analytical skills are still low and only fixated on textbooks that do not contain examples of questions related to the ability to analyze by applying everyday life events as an effort to solve the problems that exist in the problem.

After being treated by implementing STEM-oriented learning and local wisdom in the broad test class, there was an effect on learning outcomes as evidenced by the increase in post-test scores. In the indicator of analyzing incoming information to explore the relationship with a significant increase, this is because in the broad test class in the learning process students are guided to explore STEM-oriented information and local wisdom. During the learning process, students are guided to be able to relate the phenomenon of traditional games to the concepts of science and the material being studied, so that students have a better understanding to recognize the problems of phenomena that occur in society.

The effect of STEM integration in the POE learning model on the ability to analyze the concept of effort and energy in class X SMAN 2 Ponorogo. The student's ability to analyze the concept of effort and energy was measured using a multiple-choice test instrument as many as 12 questions with a reliability of 0.72 with high criteria. This ability to analyze was measured using the N-gain of the students' pretest-posttest scores. The different test of analytical ability between the experimental and control classes was calculated using the T-test. The results of the T-test showed a significant value, meaning that the ability to analyze the experimental class was different from the control class. This difference indicates that the average N-gain ability to analyze the experimental class is significantly higher than the control class. So that,  $0,003 < 0,05$  [21].

The results of the pre-test on the ability to evaluate students in the limited test class and the broad test on indicators of drawing conclusions and indicators of the position of objects that have the smallest kinetic energy in the medium category. After participating in STEM-oriented physics learning and local wisdom, the post-test results on the ability to evaluate students increased in each indicator.

The indicators for concluding have increased because in the learning process students are guided to be able to describe the phenomenon of local wisdom related to the material being studied. The influence of learning outcomes on indicators of building basic skills in the learning process, students are guided to be able to describe ideas for local wisdom phenomena related to STEM,

Learning using the STEM learning approach can improve problem-solving skills in dynamic electrical material. The ability to solve problems is carried out in five stages: a) focusing the problem, b) describing the problem into a physics concept, c) designing a solution, d) realizing the solution design, and e) evaluating the answers. At each stage, the ability to solve problems also increases. Physics learning using the STEM learning approach is recommended to be used in dynamic electricity subjects so that students' problem-solving abilities increase [22]. The ability to create students on indicators set strategies to find the amount of kinetic energy and build basic skills in determining kinetic energy in the medium category. This is because students are still difficult to master critical thinking skills. The low ability to think critically can be caused by several factors, some of which are the application of learning that is not appropriate and is not associated with the phenomenon of local wisdom that can train students to improve critical thinking skills.

The influence of STEM-oriented learning and local wisdom on the ability to create has increased. Indicators for setting strategies and tactics for students have increased because in the learning process students are guided to be able to set strategies to get the results, for example, in question number 5 we have to set a strategy to be able to find the value of the kinetic energy of object B compared to object A, so that participants Students begin to get used to compare the results of an object. The indicator for building basic skills also gets an increase because students during the learning process are guided to link learning with surrounding phenomena so that the ability to build students' basic skills can be better.

Application of STEM-based chemistry learning media to improve student learning outcomes on redox material [23]. The development of STEM-A based on local wisdom in physics learning can improve the ability to understand concepts [3]. Development of Integrated STEM Physics Module "Beduk" Local Wisdom to Improve Creative Thinking Ability of Junior High School Students [24]. In his research, he concluded that the development of STEM-based modules is known to have increased with an N-gain of 0.92 in the high category of creative thinking skills. Development of a local wisdom-based high school physics module to optimize the character of students, in his research the local wisdom-based learning module was able to optimize the character of students with an average percentage of character aspects of 86% with a very good category [25].

This study aims to determine the implementation of the STEM (Science, Technology, Engineering, and Mathematics) learning approach to improve students' critical thinking skills. The results showed that the average value of N-gain in the experimental class was 0.63 and the control class was 0.35 in the medium category. Overall, the implementation of the STEM learning approach can improve students' critical thinking skills.

## 4. Conclusion

Based on the results of research analysis and discussion of the implementation of STEM-oriented learning and local wisdom that is valid, practical, and effective so that it is feasible to use it to improve students' critical thinking skills. The conclusion is based on several things as follows. (1) This study resulted in STEM-oriented physics learning and valid local wisdom by obtaining an average final score of 3.46 and 3.45 from material experts and media experts. (2) STEM-oriented physics learning and practical local wisdom, because (a) the implementation of STEM-oriented physics learning and local wisdom can be implemented well, and (b) obstacles or obstacles in each meeting can be overcome properly. (3) STEM-oriented physics learning and effective local wisdom.

## References

- [1] R. Kustijono, "Pandangan Guru Terhadap Kurikulum 2013 dalam Pembelajaran fisika SMK di Kota Surabaya," *Jurnal Pendidikan Fisika dan Aplikasinya*, p. 95, 2014.
- [2] A.A. d. K. H. Pricilia, "Teacher expectation towards interactive multimedia integrated with STEM in learning physics: Preliminary study on geometry optic learning material," *Journal of Physics*, p. 1572, 2020.
- [3] T. N. Utami, "Pengembangan Modul Matematika dengan Pendekatan STEM (Science, Technology, Engineering, and Mathematics) Pada Materi Segiempat dan Segitiga Untuk Kelas VII SMP," *Jurnal Matematika*, pp. 34-55, 2018.
- [4] I. R. d. M. Sirait, "Efek Model Pembelajaran Berbasis Proyek dengan Strategi Think Talk Write dan Kreativitas Ilmiah Terhadap Hasil Belajar Kognitif Tingkat Tinggi Siswa SMA pada Pelajaran Fisika," *Jurnal Pendidikan Fisika*, pp. 17-24, 2015.
- [5] Y. D. a. S. Kristanti, "Model Pembelajaran berbasis Proyek pada Pembelajaran Fisika di SMA" . *Jurnal Pembelajaran Fisika*, pp. 122-128, 2016.
- [6] Winarni, "STEM: apa, mengapa, dan bagaimana," in *Prosiding Semnas Pend IPA Pascasarjana UM 1, Indonesia* , 2016.
- [7] F. Ulfah, "Peranan Kearifan Lokal dalam pendidikan Karakter," *Jurnal Sosio Didaktika*, p. 124, 2014.
- [8] A. Musanna, "Artikulasi Pendidikan Guru Berbasis Kearifan Lokal untuk Memepriapkan Guru yang Memiliki Kompetensi Budaya," *Jurnal Pendidikan dan Kebudayaan* , p. 328, 2012.
- [9] M. Khusniati, "Model Pembelajaran Sains Berbasis Kearifan Lokal dalam Menumbuhkan Karakter KOnservasi," *Indonesian Journal of Conservation*, pp. 67-74, 2014.
- [10] I. A. M. S. E. & M. H. Ilham, "Pemanfaatan Permainan Tradisional Dalam Pencapaian Indikator Pembelajaran," *Publikasi Pendidikan*, pp. 22-29, 2018.
- [11] A. Ja'far, "Penciptaan Buku Ilustrasi Permainan Tradisional sebagai Upaya Melestarikan Warisan Budaya Lokal," *Doctoral dissertation, Institut Bisnis dan Informatika Stikom Surabaya*, 2014.
- [12] M. H. L. M. T. S. M. & F. U. Syukri, "Pendidikan STEM dalam Entrepreneurial Science Thinking 'ESciT': Satu Perkongsian Pengalaman dari UKM untuk ACEH," *Aceh Development International Conference*, pp. 26-28, 2013.
- [13] Susanto, *Teori Belajar dan Pembelajaran di Sekolah Dasar*, Jakarta: Kencana, 2013.
- [14] N. Latifah, *Pengembangan Modul Fisika dengan Aplikasi Kvisoft Flipbook Maker dalam Pembelajaran Fisika untuk Meningkatkan Kemampuan Berpikir Kritis Peserta Didik*, Purworejo: Skripsi. UMP, 2018.
- [15] S. R. Yunita, "Analisis Kemampuan Berpikir Kritis Mata pelajaran Kimia pada Siswa Kelas XI IPA SMAN 1 Kepahiang," *Jurnal Pendidikan dan Ilmu Kimia*, pp. 33-38, 2018.
- [16] H. N. Dinni, "HOTS (High Order Thinking Skills) dan Kaitannya dengan Kemampuan Literasi Matematika," *Prisma*, pp. 170-176, 2018.
- [17] L. D. Anderson, *Kerangka Landasan untuk Pmebelajaran, Pengajaran dan Asesmen (Revisi Taksonomi Pendidikan Bloom)*, Yogyakarta: Pustaka Belajar, 2017.
- [18] Sugiyono, *Metode Penelitian Pendidikan : Pendekatan Kuantitatif, Kualitatif, dan R&D*, Bandung: Alfabeta, 2013.
- [19] N. S. Pratama, "Studi Pelaksanaan Pembelajaran Fisika Berbasis HOTS pada Kelas X di SMA N Kota Yogyakarta," *Prosiding Seminar Nasional Fisika dan Pendidikan Fisika (SNFPF)*, pp. 104-105, 2015.
- [20] Akhdinirwanto dkk, "Problem-Based Learning with Argumentation As A Hypothetical Model To Increase The Critical Skills For Junior High School Student," *Jurnal Pendidikan IPA Indonesia*, pp. 340-350, 2020.
- [21] N. E. Astuti, *Pengaruh integrasi STEM dalam model pembelajaran POE terhadap kemampuan menganalisis konsep usaha dan energi siswa kelas X SMAN 2 Ponorogo*, Doctoral dissertation: Universitas Negeri Malang, 2019.

- [22] M. K. I. & S. I. R. Dewi, "Penerapan pembelajaran fisika menggunakan pendekatan STEM untuk meningkatkan kemampuan memecahkan masalah siswa pada materi listrik dinamis," *Quantum: Seminar Nasional Fisika, dan Pendidikan Fisika*, pp. 381-385, 2018.
- [23] L. Y. Susanti, "Penerapan Media Pembelajaran Kimia Berbasis STEM Untuk Meningkatkan Hasil Belajar Siswa SMA/SMK Pada Materi Redoks," *Jurnal Pendidikan Sains*, pp. 32-40, 2018.
- [24] F. A. Almuharomah, "Pengembangan Modul Fisika STEM Terintegrasi Kearifan Lokal "Beduk" untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa SMP," *Berkala Ilmiah Pendidikan Fisika*, pp. 1-10, 2019.
- [25] F. Hidayanto, *Pengembangan Modul Fisika Berbasis Kearifan Lokal untuk Mengoptimalkan Karakter Peserta didik*, Purworejo: UMP, 2016.
- [26] N. Khoiriyah, "Implementasi pendekatan pembelajaran STEM untuk meningkatkan kemampuan berpikir kritis siswa SMA pada materi gelombang bunyi," *Jurnal Riset Dan Kajian Pendidikan Fisika* 5.2, pp. 53-62, 2018.
- [27] H. G. V. d. Werfhorst, "Skill and education effects on earnings in 18 Countries: The role of national educational institutions," *Social Science Research*, pp. 1078-1090, 2011.