Original Article

Facing the Era of Educational Disruption through STEAM Learning Method in the Independent Learning Curriculum

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Abstract: *STEAM (Science, Technology, Engineering, Art, and Math) is a method of learning that has a level of creativity and innovation, so STEAM is used as an alternative in the teaching and learning process. The STEAM method in its application combines the creativity and innovation of teachers and students in a collaborative effort. The application of the STEAM method to learning in developed countries has been around for a long time, even before the COVID-19 pandemic occurred. The purpose of this study is to explain steam: the teacher's learning method in the independent learning curriculum in the face of an era of educational disruption. The research method used in this study is library research with a qualitative, descriptive approach. Data collection uses literature review techniques from books, journals, and other scientific articles. The results of this study explain that independent learning is a curriculum that provides students with broad opportunities to learn and develop cognitive and interpersonal abilities. To realize this, of course, a curriculum requires a creative and innovative learning method, namely the STEAM method. The STEAM method of learning invites students to see the relevance of the five branches of knowledge through learning activities that can improve students' ability to think critically and creatively. Students have the opportunity to explore their own knowledge to solve the given problem. As a result of students' abilities, the independent learning curriculum is able to deal with educational changes that occur.*

Keywords: STEAM, Freedom to Learn, Educational Disruption Era.

I. INTRODUCTION

Currently, the term disruption comes from the word disruption. The term disruption first appeared in the context of business, investment, and finance. However, its meaning evolved over time to include politics, entertainment, government, social issues, leadership, and education. This disruption process has been going on for a long time and tends to repeat itself. The difference is that now the information technology development cycle is faster, so we have to be more responsive to changes that will occur (Jf, 2022). The era of disruption has affected the world of education; this is shown by the emergence of Google, which was able to shift the position of libraries as a source of reference searches and shift to digital libraries. Furthermore, the rise of homeschooling as a learning alternative for students and universities has implemented distance learning through the use of online media as a learning medium in addition to modules and non-print media such as videos. So that education now uses technology in its learning (Herman, 2021).

Education is a place where students can determine their own destiny because students' individual thinking patterns and creativity are influenced by education. Teacher explanations about the learning process can be the key to academic success. A country is considered developed if its education system is of high quality (Russo-Netzer, 2023). Meanwhile, learning is an activity designed for the learning process and given to students based on the goals they want to achieve (Thompson, 2023). According to the education unit curriculum, a good learning process requires educators to act as facilitators for students to create active, innovative, creative, and fun learning. However, in reality, the learning currently being carried out is still less active because the methods used by teachers are still conventional. This conventional method is always teacher-centered and does not give students freedom when learning is carried out. So students cannot be active in learning, which makes them unable to explore innovation and creativity within themselves (Tabroni et al., 2022).

The learning that is currently being implemented needs to be changed; these changes can be made by the teacher, who plays the main role in implementing learning through the methods used. To create learning that involves student activity, explores student creativity, and is fun for students, one of the methods that teachers use can be realized. Apart from that, the methods used by teachers can also determine success in the learning process (Wu et al., 2022). The learning methods used by teachers in learning no longer use conventional methods considering that the increasingly rapid development of technology means that various forms of life are technology-based, including in the field of education, which is demonstrated by the rapid development of science and technology. One learning method that can be used by teachers for learning that is in line with technological developments is the STEAM method (Utaminingsih et al., 2023).

STEAM consists of several words, namely science, technology, engineering, art, and mathematics. STEAM is an innovation in learning and was previously known as STEM (Science, Technology, Engineering, and Mathematics). STEAM is an integrative approach to education that combines science, technology, engineering, arts, and mathematics to develop students' inquiry, communication, and critical thinking skills during the learning process (Bertrand & Namukasa, 2023). STEAM is an adaptation of STEM that emphasizes connections between two or more content areas and guides instruction through observation, investigation, and problem solving. So this makes STEAM a suitable method for teachers to use, considering rapid technological developments like this. Apart from that, the STEAM method can create active, innovative, creative, and fun learning (Salwa Zata Shabrina, 2022).

This STEAM method has been implemented since the 2013 curriculum, but currently Indonesian education is using the independent learning curriculum, where this concept was initiated by Nadiem Makarim as Indonesia's minister of education. It is hoped that this freedom of learning will be a stepping stone in improving the quality of education, with the hope of producing students who are superior and able to face future challenges. So it is hoped that freedom to learn can influence and implement effective learning, be able to create a more enjoyable and meaningful learning atmosphere, and involve more student participation. This is in line with the STEAM method, which combines five fields of science by emphasizing student participation, students' critical thinking, and exploring their creativity (Rahmadana & Agnesa, 2022). So the STEAM method is one of the learning methods that can be applied by teachers in the independent learning curriculum, where this curriculum gives students freedom in learning. The application of the STEAM method in the independent learning curriculum is also used as an answer to facing the era of educational disruption. so that the education carried out in the learning process can form students who have competencies in accordance with current developments.

Based on the background above, the researcher intends to conduct research regarding STEAM: Teacher Learning Methods in the Independent Learning Curriculum in Facing the Era of Educational Disruption.

II. THEORETICAL STUDY

A. STEAM

STEAM is a learning method that explores two or more subjects. According to Katz-Buonincontro, STEAM is STEM learning that is integrated with the arts. National Research Council, US, in interpreting each aspect of STEM. Science is defined as the study of nature, which is related to physics, chemistry, and biology, as well as the treatment and application of related facts, principles, concepts, or habits. Technology is defined as the entire system, starting with the people involved, organizations, knowledge, processes, and devices used to create and operate technological tools, as well as the tools themselves. Engineering is the knowledge of the design and creation of products and processes used to solve problems, while mathematics is defined as the study of the relationship between quantities, numbers, and shapes. Mathematical science, which includes theoretical mathematics and applied mathematics (Anizal & Hartati, 2022).

The STEAM learning method is a contextual learning method that helps children understand what is happening around them. Children learn to solve problems through STEAM education, which helps them improve their critical thinking skills and general knowledge. Children learn best when they are actively involved in the process and have opportunities to practice the knowledge they have learned (Amelia & Marini, 2022). The STEAM learning method has a positive impact on learning. The STEAM learning method can develop students' skills, attitudes, and cognition. In this learning, students are not only taught theoretically but also practically. In this way, children will directly experience the learning process that is carried out, so that students will have more knowledge, and this knowledge can be easily remembered (García-Fuentes et al., 2023).

The benefit of the STEAM learning approach is that it encourages students to think holistically about issues related to science, technology, engineering, the arts, and mathematics. Students can be encouraged to think critically and generate solutions to problems in this way. The systematic integration of knowledge, concepts, and abilities in the STEAM approach enables meaningful learning to be achieved for a learner. Students inherently have the potential, interests, and skills needed for a project, and this information can be gathered in a way that the student prefers. Because learning is student-centered, this stage can lead to independent learning (Elvira et al., 2022).

B. Independent Learning Curriculum

Based on the Big Indonesian Dictionary (KBBI) in accordance with the Ministry of Education and Culture, independent learning consists of two words, namely independence and learning, both words have their own meanings. "Freedom" means "free, independent, not influenced or free from demands, not bound, and not dependent on people". Meanwhile, "learning" refers to the process of attempting to gain intelligence or knowledge through practice and changes in behavior or reactions caused by experience. The two words are combined to form a self-study phrase. Freedom of learning is unlimited freedom in the classroom that allows students to reach their full potential in terms of intellectual capacity, morals, and other skills (I Putu Tedy Indrayana, 2022).

Minister of Education and Culture of the Republic of Indonesia (Kemendikbud RI), Nadiem Anwar Makarim, launched a new education policy initiative called Merdeka Belajar. Nadiem has strong reasons for instituting an independent learning policy. This is because the evaluation results of Indonesian students only rank sixth from the bottom in the fields of mathematics and literacy; Indonesia ranks 74th out of 79 countries, according to the 2019 Program for International Student Assessment (PISA) research (Sopiansyah, 2022).

Nadiem Anwar Makarim believes that educators must first educate students about the basics of freedom of thought before entrusting them with responsibility. According to Nadiem, teacher competency learning at any level will never exist unless basic skills and the existing curriculum are translated. Merdeka Learning, a policy curriculum program developed by Nadiem Makarim, aims to create a happy and enthusiastic learning environment free from pressure to meet certain scores or grades.

C. Era of Educational Disruption

Disruption is defined as surprise, chaos, and disturbance. Disruption means fundamental changes that have occurred in the industrial and business sectors, for example, public transportation media, information media, and communication media. The figure who introduced the concept of disruption as a concept or theory around 1997 through his publication "The Innovator's Dilemma" was Clayton M. Cristensen. Fitriani traces the history of disruptive discourse in Indonesia. He believes that the discourse of disruption emerged as a result of the publication of the disruption book series, which was popularized by Rhenald Kasali, and by the Indonesian Academy of Sciences (AIPI), which published the book "Era of Disruption: Opportunities and Challenges of Indonesian Higher Education." (Nurfadilah et al., 2022).

Along with the development of various applications and the development of start-up businesses, the term disruption is becoming increasingly popular. Young people seem more motivated to start their own business than just looking for work. They are not just entrepreneurship but rather disrupting industry, reviving and replacing old methods with new ones (Maula et al., 2023).

Disruption theory comes from economic studies, namely from global economic difficulties when facing a crisis. Rhenald Kasali is of the opinion that the waves of crises that have come continuously have made it difficult for many people. In 1988, the Indonesian economy experienced the peak of the crisis, and in 2006, the Indonesian economy experienced a process of economic recovery. The continuation of the crisis, of course, creates impulses for change that direct economic actors and society to look for new guidance. In the midst of widespread economic problems, starting with the increasing frequency of layoffs of workers and the soaring prices of commodities, services, housing, transportation, and the like, encourage young people to try to carry out a revolution by making products and services cheaper so that new businesses can be created. According to Taufik Abdullah, the main factor in the incessant disruption is the necessity of a developmentalism attitude, which is still a tradition in the world of Indonesian higher education, thus defeating the position of science as a system of scientific knowledge (Arum & Ismaya, 2022).

III. MATERIALS AND METHODS

This research uses a type of library research that emphasizes the study of texts because the data sources used are literature. The approach to this research uses descriptive-qualitative methods to explain facing the era of educational disruption through the STEAM learning method in the independent learning curriculum. The data obtained in this article comes from books, journals, and other scientific works. Furthermore, the relevant data is used to support the author's ideas and is used as the basis for writing this article. After the data was collected, the researcher carried out data analysis in three stages, including data reduction, data presentation, and drawing conclusions, which were part of the process. Data reduction is a researcher's activity in selecting data from observations, interviews, and documentation, then processing the data to make it easier for researchers to present the data. The next step is to present the data that has been obtained and reduced, and then the data is presented in narrative form. The final step is to provide a conclusion. The data presented is then used to draw conclusions, or what is usually called the researcher's argumentation.

III. RESULTS AND DISCUSSION
A. The Relevance of the Independent Learning Curriculum Policy in the Era of Disruption

Technological developments are one of the main reasons that change occurs in all lines of human life. Today's technological developments have led to digitalization, which in this digital era has made human life easier. Previously, we were familiar with the term Industrial Revolution Era 4.0, which is a comprehensive form of transformation in the production aspects of industrial companies by utilizing digital or internet-based technology. This era has disrupted many human life activities in various fields, one of which is education. Putriani and Hudaidah stated that the emergence of the industrial revolution had a huge impact in the field of technology, resulting in major changes in the world of education and society. Not long after the emergence of the Industrial Revolution Era 4.0, a new concept was born that was initiated by

Japan, and this concept was named Society 5.0. In this concept, it is more possible for humans to utilize science based on artificial intelligence (AI), which will make human life even easier. Maghfiroh & Sholeh said that with the emergence of Society 5.0, it will be easier for humans to develop their abilities in all things through the use of existing technology. Japan, through the concept it created, hopes that humans can continue to develop despite the rapid development of artificial technology. Currently, various countries in the world are shocked by the changes that are happening so quickly, so countries in the world are currently continuing to make various efforts so that their countries are not left behind by increasingly sophisticated artificial technology (Maghfiroh & Sholeh, 2022).

Indonesia itself has started to rush in terms of improving the quality of various aspects of life, such as in the educational and social fields. Remember that these two aspects cannot be separated from each other because, in essence, good quality education will influence the social life of a prosperous society. This is demonstrated by the presence of an independent campus learning curriculum. Merdeka Belajar, or independent campus learning, is an effort to provide autonomous freedom to all educational institutions from elementary to higher education so that they can be free from the constraints of bureaucratization, lecturers are free from complicated bureaucratization, and students are free to choose their own scientific fields if they like. Currently, an innovative and adaptive curriculum is needed in order to welcome the era of disruption. In this era, changes are occurring so rapidly in all walks of human life, including the world of education; thus, the educational curriculum must be flexible if it does not want to be eroded by changing times.

The Merdeka Belajar curriculum is present as an answer to the intense competition for human resources globally in the era of disruption. Lukum said that there are three major competencies that a person must have if they want to be a winner in the current era of disruption, including the competencies to think, act, and live in the world. Thinking competencies include critical, creative, innovative thinking, and problem solving. Action competencies include the ability to communicate and collaborate, as well as the ability to be digitally and technologically literate. Meanwhile, competencies for living in the world include having initiative, self-direction, global understanding, and a sense of social responsibility. These three competencies are, of course, very necessary in this era, which also requires creative and innovative people to easily adapt in the face of rapid changes. In this way, Indonesia has begun to make improvements by preparing facilities and infrastructure to meet world developments in the era of disruption. Curriculum development is a strategic step to face this era (Lian & Amiruddin, 2021).

Society continues to experience developments; for example, at first the society still thought primitively, living nomadically, then it changed to an agrarian society, then it changed to an industrial society, and today it has experienced a shift towards an informative society. This informative society is a sign of digitalization, and internet use is an example of digitalization. The existence of the internet has changed people's lives from offline to online. In the last five years, internet use in Indonesia has experienced very rapid development. As proof, internet use in households reached 78.18%. Internet use in households is, of course, also balanced by the growth in the number of people using cell phones, reaching 62.84%. Computer ownership in households in 2020 increased to 18.83%. Based on data released by the Central Bureau of Statistics (BPS) in 2020, the Indonesian population using the internet in 2016–2020 experienced a significant increase from year to year. This increase occurred in both urban and rural areas. In urban areas, internet users in 2016 reached 35.86% and increased to 64.25% in 2020. Meanwhile, in rural areas, internet users in 2016 reached 14.25% and increased to 40.32% in 2020. With The increase in internet users in Indonesia has changed many things, starting with education and the order of people's lives (Indarta et al., 2022).

B. Implementation of the STEAM Learning Method in the Independent Learning Curriculum

Children's professional abilities can be developed in terms of skills, knowledge, and abilities in terms of developmental factors by applying the STEAM method to preschool children. The application of STEAM, which is based on Fred Rogers' philosophy of early childhood education, also emphasizes learning that builds social and emotional skills as well as arts and sciences and develops students' knowledge through hands-on exploration of their surroundings.

The first stage of teacher planning for STEAM learning activities begins by offering students real-world challenges to be used as material in the planning process that will be used to solve difficulties. After this activity, the teacher acts as a facilitator, dividing the class into groups based on each student's abilities and interests. After arranging the activities to be completed, students proceed to the second stage, namely creating a timeline for when these activities can be completed. The third step is observation and reflection, in which the teacher tracks the progress of the project and requests brief reports on its status. After the project was completed, the students presented their findings, accompanied by the posters they created. After that, start contemplating (Santi, 2022).

The STEAM learning method can also be used in early childhood education, where children are actively involved in all aspects of the learning process, working together, using their creativity, and taking calculated risks when solving problems. The STEAM learning method prioritizes collaborative activities.

C. Teachers' STEAM Learning Method in the Independent Learning Curriculum in Facing the Era of Educational Disruption

STEAM-based learning is a new breakthrough in the world of education in Indonesia. Not too many teachers have implemented STEAM in their learning at school. Curriculum changes in Indonesia up to the 2013 curriculum indicate that the government has made improvements in education. The 2013 curriculum, which integrates learning thematically, will be very suitable to be combined with STEAM-based learning. Apart from that, the currently emerging curriculum development, namely independent learning, makes STEAM-based learning still suitable for use because the independent learning curriculum gives students freedom in learning. This is in line with the STEAM concept, which aims to make the learning carried out by students more creative, innovative, and enjoyable so that students are able and free to explore their competencies. Wijaya et al. stated that elementary and junior high schools are educational unit levels that are suitable for implementing STEAM-based learning. This is because at this level, each subject is taught in an integrated thematic manner (Mohamad Reza Muji Ashari, 2022).

In STEAM-based learning, a teacher will face the challenge of how to encourage students to be able to use their understanding and logic actively, think critically and creatively, and use problem-solving skills. The teacher is not only a facilitator; the teacher must also take part and build understanding to create a relationship between the scientific disciplines contained in STEAM. In STEAM group learning, teachers can move between groups to observe, provide stimulus in the form of questions, provide opinions and suggestions, and provide value to the products produced. Meanwhile, students together in a group learn to build an understanding of the concepts being discussed and learn how to make integration connections between disciplines in STEAM.

When students are faced with the concept of building space, they must be able to develop this concept in other scientific disciplines. Building spaces can be created and designed using different techniques. Each room can also be designed by adding artistic elements to each creation, for example, adding color to each side of the room. Creating and learning to build space can be done using mathematical software technology, one of which is geometry. The implementation of STEAM in learning can produce a complex and perfect learning product, improving the quality of education.

IV. CONCLUSION

Based on the results and discussion above, it can be concluded that an innovative and adaptive curriculum is currently very necessary in order to welcome the era of disruption. In this era, changes are occurring so rapidly in all walks of human life, including the world of education; thus, the educational curriculum must be flexible if it does not want to be eroded by changing times. The MBKM curriculum is present as an answer to the intense competition for human resources globally in the era of disruption. Independent learning is a curriculum that provides students with extensive opportunities for learning to develop cognitive and interpersonal skills. To realize this, of course, a curriculum requires a creative and innovative learning method, namely the STEAM method. The STEAM method of learning invites students to see the relevance of the five branches of knowledge through learning activities that can improve students' abilities to think critically and creatively. Students have the opportunity to explore their own knowledge to solve the problems given. So that students have the ability in their independent learning curriculum to be able to face the educational changes that occur.

V. REFERENCES

[1] Amelia, W., & Marini, A. (2022). Urgensi Model Pembelajaran Science, Technology, Engineering, Arts, and Math (STEAM) untuk Siswa Sekolah Dasar. *Jurnal Cakrawala Pendas*, *Vol. 8 No.*(1), 291–298.

[2] Anizal, D. R., & Hartati, S. (2022). Penerapan Pembelajaran Berbasis STEAM (Science , Technology , Engineering , Art & Math) di Taman Kanak-Kanak Hang Tuah Padang. *Jurnal Ilmiah PESONA PAUD*, *9*(1), 33–45.

[3] Arum, F., & Ismaya, E. A. (2022). Transformasi Pendidikan dalam Pengembangan Sumber Daya Manusia yang Berkarakter di Era Disrupsi. *Guru Tua : Jurnal Pendidikan Dan Pembelajaran*, *5*(2), 21–30.

[4] Bertrand, M. G., & Namukasa, I. K. (2023). A pedagogical model for STEAM education. *Journal of Research in Innovative Teaching and Learning*, *16*(2). https://doi.org/10.1108/JRIT-12-2021-0081

[5] Elvira, M., Islam, U., Maulana, N., & Ibrahim, M. (2022). *Model Pembelajaran STEAM (Science , Technology , Engineering , Art , and Mathematics) di Kota Malang*. *4*(1), 13–20.

[6] García-Fuentes, O., Raposo-Rivas, M., & Martínez-Figueira, M. E. (2023). STEAM education: review of literature. *Revista Complutense de Educacion*, *34*(1). https://doi.org/10.5209/rced.77261

[7] Herman, H. (2021). The Transformation of Educational Management in the Disruption Era. *Tazkir : Jurnal Penelitian Ilmu-Ilmu Sosial Dan Keislaman*, *7*(1). https://doi.org/10.24952/tazkir.v7i1.4216

[8] I Putu Tedy Indrayana, D. (2022). *Penerapan Strategi dan Model Pembelajaran Pada Kurikulum Merdeka Belajar*. CV. Media Sains

Indonesia.

[9] Indarta, Y., Jalinus, N., Waskito, W., Samala, A. D., Riyanda, A. R., & Adi, N. H. (2022). Relevansi Kurikulum Merdeka Belajar dengan Model Pembelajaran Abad 21 dalam Perkembangan Era Society 5.0. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(2), 3011–3024. https://doi.org/10.31004/edukatif.v4i2.2589

[10] Jf, Z. N. (2022). Problems Of Early Childhood Development In The Era Of Disruption. *Proceeding International Seminar Of Islamic Studies*, *3*(2020).

[11] Lian, B., & Amiruddin, A. (2021). Peran Pendidikan Dalam Menciptakan Sdm Berkualitas Di Era Disrupsi Dan Pandemi Covid-19. *Prosiding Seminar Nasional PGRI Provinsi Sumatra Selatan Dan Universitas PGRI Palembang*, *November*, 12–15.

[12] Maghfiroh, N., & Sholeh, M. (2022). Implementasi Kurikulum Merdeka Belajar Kampus Merdeka Dalam Menghadapi Era Disrupsi Dan Era Society 5.0. *Jurnal Inspirasi Manajemen Pendidikan*, *09*(05), 1185–1196.

[13] Maula, F. I., Murwani, F. D., Hermawan, A., Nasikh, & Wardana, L. W. (2023). Challenges of Business Success in Era of Disruption. *Journal of Higher Education Theory and Practice*, *23*(6). https://doi.org/10.33423/jhetp.v23i6.5979

[14] Mohamad Reza Muji Ashari, D. (2022). INTEGRASI PEMBELAJARAN STEAM " MATHEMATIC ' S MEAL " KELAS V SEKOLAH DASAR SEBAGAI IMPLEMENTASI MERDEKA BELAJAR Mohamad Reza Muji Ashari Neni Mariana Abstrak. *JPGSD*, *10*(5), 959–972. http://jurnal.umpwr.ac.id/index.php/jpd/article/view/2240

[15] Nurfadilah, S., Sutarjo, S., & Karyawati, L. (2022). Rekonstruksi Kurikulum Pendidikan Islam Berbasis Keterampilan Abad 21 Di Era Disrupsi. *Jurnal Pendidikan Tambusai*, *6*, 9833–9841. https://jptam.org/index.php/jptam/article/view/3977

[16] Rahmadana, A., & Agnesa, O. S. (2022). Deskripsi Implementasi Steam (Science, Technology, Enginering, Art, Mathematic) dan Integrasi Aspek "Art" Steam pada Pembelajaran Biologi SMA. *JOTE: Journal on Teacher Education*, *4*(1), 190–201.

[17] Russo-Netzer, P. (2023). Recalibrating the Compass in a Changing World: Education for Meaning and Meaningful Education. *Journal of Constructivist Psychology*, *36*(2). https://doi.org/10.1080/10720537.2022.2068708

[18] Salwa Zata Shabrina, H. S. (2022). Analisis Penerapan Pembelajaran STEAM di Sekolah Dasar. *EduCurio Jurnal*, *1*(2), 209–216.

[19] Santi, E. L. (2022). Pendekatan STEAM Pada Project Based Learning Mewujudkan Merdeka Belajar Untuk Meningkatkan Kreativitas Siswa. *Jurnal Pendidikan Dasar*, *3*(2), 77–81. http://jurnal.umpwr.ac.id/index.php/jpd/article/view/2240

[20] Sopiansyah, D. (2022). Konsep dan Implementasi Kurikulum MBKM (Merdeka Belajar Kampus Merdeka). *Reslaj: Religion Education Social Laa Roiba Journal*, *4*(1), 34–41.

[21] Tabroni, I., Lestari, E. S., & Hermaningsih SM, H. (2022). Efforts To Increase Students' Learning Motivation In Al-Qur'an Hadith Lessons About The History Of The Decline And Writing Of The Qur'an With CBSA. *Jurnal Multidisiplin Madani*, *2*(2). https://doi.org/10.54259/mudima.v2i2.440

[22] Thompson, P. (2023). What's in a Name? The Meaning of "Learning, Design, and Technology." *TechTrends*, *67*(2). https://doi.org/10.1007/s11528-022-00814-w

[23] Utaminingsih, E. S., Ellianawati, E., Sumartiningsih, S., & Puspita, M. A. (2023). STEAM Education. *Jurnal Ilmiah Profesi Pendidikan*, *8*(3), 1605–1612. https://doi.org/10.29303/jipp.v8i3.1566

[24] Wu, L., Wen, Y., Leng, D., Zhang, Q., Dai, C., Wang, Z., Liu, Z., Yan, B., Zhang, Y., Wang, J., He, S., & Bo, X. (2022). Machine learning methods, databases and tools for drug combination prediction. *Briefings in Bioinformatics*, *23*(1). https://doi.org/10.1093/bib/bbab355