



Product Development of Unique Clothing Learning Media to Stimulate Fine Motor Skills of 4-5 Years Old Children

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ABSTRACT

The purpose of this study was to create a learning model product in the form of unique clothing to stimulate fine motor skills of children aged 5-6 years in Purwakarta. The research method used a mixed method with a research and development (R&D) design. The research process starts from making a product design design using media with materials around, in the form of used gallon bottles, design validation, revision, making products, limited product trials, making products, stage 1 product revision, main field trials, revision 2, operational field trials, product revision 3, dissemination and product marketing. The results of research on the development of unique clothing learning models to stimulate fine motor skills are more creative and innovative learning models. The results of the research in the form of children's fine motor movement skills are getting better and children's fine muscles are getting stronger and more skillful. This unique clothing model gives children the interest to be able to play it so that fine motor skills are stimulated in a fun way. The technique supports children's understanding of attitudes, motivation and curiosity towards psychomotor activities (fine motor). This broad trial was conducted three times and experienced good improvement, so it is hoped that this model can be disseminated to PAUD institutions in Purwakarta and surrounding areas.

Keywords: Development, Learning Model, Fine Motor

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INTRODUCTION

Motor abilities or skills are functions that involve specific movements of the body's muscles to perform specific tasks (Vial, 2019). These tasks can include walking,

running, or riding a bike (He dkk., 2019). To perform these skills, the body's nervous system, muscles and brain must work together. Gross motor movements are activities that use large muscle muscles, such as running, jumping, dancing, gymnastics, swimming, pedaling a bicycle and so on, while fine motor activities are squeezing, cutting, sewing, tearing, buttoning, unzipping, filling objects into bottles, weaving, matching, folding and many more. According to Ismail (2009: 84) movements carried out by certain body parts that do not require great energy but only involve some subtle members (Song dkk., 2020). Sujarwo (2006) says the control of smaller muscles and can be used for grasping, using tools, writing, skillful movements have not been mastered before the child's muscle mechanism develops is called fine motor.

Fine motor development that is stimulated in children will make children skillfully use their hands which include their fingers and coordination between hands and eyes well. Referring to the STPPA indicator standards (Standard Level of Achievement of Child Development) regarding Fine Motor in children aged 4-5 years, namely (1) Making vertical, horizontal, curved lines now / right, left / right sloping, and circles, (2) Tracing shapes (3) Coordinating eyes and hands to perform complex movements (4) Performing manipulative movements to produce a shape using various media (5) Expressing themselves by creating art using various media (6) controlling hand movements that use fine muscles (grasping, stroking, poking, clenching, twisting, squeezing) (S. Wang dkk., 2019). Fine motor skills will also help other abilities such as: cognitive, language, social emotional, and art (Peng dkk., 2020). This is because doing activities or skills requires accuracy, concentration, patience and creativity (Hu dkk., 2019). Children who have fine motor skills with a faster time and have creativity in their work. Fitria, Wulan, & Yarshal (2018) explain fine motor skills are the ability to coordinate hands and eyes in regulating finger movements and hand movements (Penconek dkk., 2021). Beaty (2013) argues that fine motor skills are skills that use fine muscles in controlling hand movements including control, dexterity, and coordination in using hands and fingers. Santrock (2007) suggests that fine motor skills are skills that use finely regulated movements, namely finger skills.

The obstacle that often occurs in the field is, when children begin to enter elementary school, there are still some children who have difficulty in writing, are still stiff and tend to lack emphasis in writing (Caniëls dkk., 2019). This is certainly influenced by various things, one of which is teacher creativity. Referring to what was conveyed by Learning in early childhood education must be truly creative and comfortable so that early feel happy and happy in achieving its development. Limited creative and innovative learning media to attract children aged 4-5 years which affects their development in fine motor activities (Pfattheicher dkk., 2022). So that with this product it is hoped that children will be more interested in activities related to fine motor learning.

The unique clothing made is adapted to the characteristics of early childhood, namely learning while playing. The development of a learning model in the form of unique clothing, combined with gallons of mineral water so that it has an attraction for

children in playing it. Where children will be stimulated by opening and closing zippers, installing buttons, installing snap buttons, installing ribbons, installing objects in the form of pebbles / seeds.

ukan objects in the form of pebbles / seeds into gallons, pairing gloves on fingers, pairing rings and so on (Van Doren dkk., 2019). So that way children become motivated in activities (F. Wang dkk., 2019). With frequent stimulation, children will have skills that improve their fine motor skills.

The application of unique clothing media as learning media in PAUD is the first to be carried out, because this product is the first to be initiated and tested (Low dkk., 2019). Based on the results of observations and feasibility tests that have been carried out in the first stage, satisfactory results can be obtained about the use of this unique clothing learning media (Chen dkk., 2019). Early childhood education is an effort made in the form of coaching for early childhood from birth to 7 years of age which is carried out through providing educational stimuli both spiritually and physically so that children are better prepared to face.

Based on the results of interviews with Mrs. Neneng at RA. Royhan conducted on March 25, 2023 found that fine motor stimulation activities in the classroom are currently less interested in children because of monotonous activities (Yang dkk., 2019). After the first product trial, it was seen that the children were enthusiastic about the stimulation activities, so it was hoped that the children would be more skilled in strengthening the muscles in the fingers (Gao dkk., 2021). The following are the steps in making, how to play and the overall product. This unique outfit is made of materials in the form of flannel, snap beans, zippers, buttons, ribbons for sewing, binding, hooks, and applied to the media in the form of gallons (Bai dkk., 2021). This media is also given a mouth to insert seeds / pebbles and even liquid objects using a spoon (Golden & Gajendran, 2019). In this unique clothing model, two types are also made, namely male and female, so that children know the differences between boys and girls (Hassan dkk., 2021). All of these activities are intended to stimulate or stimulate children's fine motor activities, although cognitive, language, religious and moral values and socio-emotional aspects of children's development are touched.

LITERATURE REVIEW

Unique clothing can have a variety of meanings depending on the context. However, if we're talking about truly unique clothing, then there are a few examples we can look at, such as:

1. Clothes with unusual designs, such as clothes with uncommon patterns or images.
2. Clothes made from unique or unusual materials, such as clothes made from crocodile skin or rare animal fur.
3. Specially designed clothes with unusual features, such as clothes with LED lights or clothes that can change shape.

4. Clothing decorated with unusual accessories, such as clothing decorated with bird feathers, flowers, or sequins.

Regardless of shape or type, unique clothing is clothing that stands out and sets the wearer apart from others. Some fashion and design experts may have different views on unique clothing.

Being a teacher must have many ways to make the stimulation process at school more enjoyable such as having a cheerful disposition, interesting learning media, and preparing children both physically and psychologically so that children are ready to receive learning (Vial, 2019). For this reason, teachers are required to have a special strategy by choosing the right learning approach or method (Albrecht & Chin, 2020). Methods play a big role for a teacher in the process of teaching and learning activities. Teachers can use learning methods with available and fun models with learning media available around them, by creating creative innovations, so that children are more interested in activities.

One of the learning media used by researchers is unique clothing, which is clothing used as learning media created to attract children's interest in learning. Unique clothing itself is designed to accommodate all children's fine motor activities, such as attaching buttons (Arora dkk., 2019), opening and closing zippers, putting solid / liquid objects into bottles, sewing with ribbons, hooking skirts / pants and much more (Zhang & Jin, 2020). These activities are done to stimulate the child's motor activities. The series of activities using this unique clothing is that children play all the activities that are already available in unique clothing media that are packaged with objects in the form of water gallons. Children can practice/operate how to use and explore all the learning activities that have been prepared in the media.

What is also important to note in providing learning to early childhood is to create a learning experience that is fun and enjoyable, so that it is more attached because the child experiences it himself. According to Behavioristic Learning Theory, it contains changes in behavior that occur due to learning experiences. In its development, this theory became a school of learning psychology that influenced the goal of improving learning theory and practice in the world of education and learning. Learning by using unique clothing media, learning will form a mastery process because of the interaction in learning (Fahyuni et al: 2013).

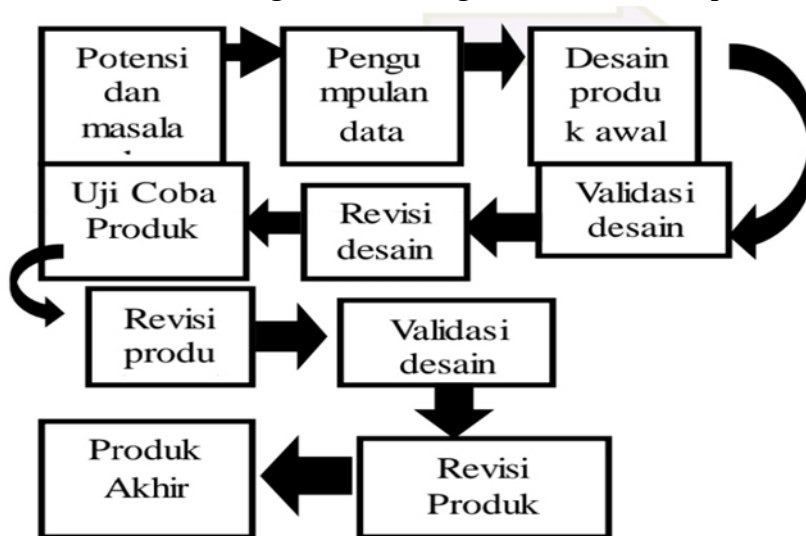
RESEARCH METHODOLOGY

Research and Development (R&D) is the right type of research to use in this study. Where a series of processes or steps in an effort to develop a new product or improve existing products to be accountable (Salim Khaidir: 2019).

In conducting Research and product development (R&D) research, it is necessary to pay attention to several procedures, so that the products produced can be widely applied (Rifki Amin: 2015). The Research and Development (R&D) research method is a research method used to produce certain products and test the effectiveness of these products. To produce certain products used research that is needs analysis and to test the

effectiveness of these products so that they can function in the wider community, research is needed to test the effectiveness of these products. In conducting R&D development research activities, it is necessary to pay attention to the procedure so that the resulting product is widely applied. The development used in this study is to use the R&D development procedure according to Borg and Gall which consists of 10 stages of research (Sugiyono, 2013). Research procedures are steps used in obtaining basic information, in order to answer the questions used in research, so that the expected results are in accordance with research procedures and in drawing conclusions there is no doubt. (Ajat Rukajat: 2018). The stages proposed by Borg and Gall are shown in the following figure:

Figure: 3.1.1 Stages of R&D Development



RESULT AND DISCUSSION

Research and Development Procedures

Potential and Problems

This research and development is motivated by the potential and problems, the potential in research and development is the rapid development of early childhood learning media, especially media in the form of Unique Pwkaian APE. The problems identified in early childhood institutions as observations made at RA Royhan Purwakarta district have the results of child development in Fine Motor skills. Then related to the learning media used has not used APE in the form of Unique Clothing. This is known to be a problem because teachers have not made much of their own media and still depend on existing teaching aids as well as the dominance of using LKA as a child's activity.

Data Collection

In this process, stages are carried out in the form of linking the research objectives of the formulation of known problems by looking for relevant reference sources that will strengthen the research findings carried out. In addition, after conducting observation and learning activities carried out with Unique Clothing APE at the

institution. This information is very useful for researchers to develop needs and also the right design in overcoming these problems. Especially the concept that will be compiled by exploring this information so that the media developed really has the benefit of being used by the institution.

Product Design

The design process is tailored to the needs, especially the expected developmental achievement goals are the fine motor skills of children, so an APE media is designed in the form of unique clothing where through this media children have interesting variations in stimulating their fine motor development, as well as in motivating children to become more skilled with finger muscle strength and coordinating hands and eyes.

The steps taken in designing this product are to prepare activities that can support learning outcomes, so that children's fine motor skills can be stimulated properly. Such as opening and installing shirt buttons, opening and closing pants zippers, simple sewing, installing and opening snap buttons, installing and opening velcrow, and wearing ribbons / straps as belts. By using an interesting color composition and in accordance with the characteristics of early childhood. The production of this product uses materials that are around, such as mineral water gallons, flannel cloth, snap buttons, buttons of various sizes (large, medium, small), velcrow, zippers, ribbons, and ropes.

Design Validation

At this stage after the initial product is finished, then validate it to a team of experts consisting of material experts and media experts as follows:

1. Material experts review aspects of material study in the form of material feasibility
2. Media experts review, elements of suitability and ease of use of the media.

Design Revision

This step is an improvement in the design of fine motor pillow media, based on the input provided by material experts and media experts. So that through these improvements it is more motivating for children to play the APE.

Product Trial

In this study, quantitative research was conducted using the preexperimental design method of the one group pretest posttest type (single group pretest final test). Arikunto (2010: 124) says, that one group pretest-posttest design is a research activity that provides an initial test (pretest) before being given treatment, after being given treatment, then gives a final test (posttest).

Manufacturing Process

In the process of making unique clothes, several materials are needed to maximize the results of the work in the form of:

1. Mineral water gallon
2. Flannel fabric
3. Buttons of various sizes
4. Snap buttons

5. Zipper
6. Velcrow
7. String
8. Ribbon, etc.

the concept will be made a kind of robot wearing clothes and pants, there are hands, and a face.

Sugiyono (2013: 3) states that, research methods are scientific ways to get data with specific purposes and uses. The research method is a way of working to examine and understand objects with reasonable and logical procedures and there is a valid data acquisition. The research method used in this research is the experimental research method. Sugiyono (2013: 107) states that the experimental research method can be interpreted as a research method used to seek the effect of certain treatments on others in observed conditions.

Arikunto 2010: 123) states, that preexperimental designs (nondesign) are often seen as experiments that are not real. Therefore it is often referred to as a quasi-experiment. It is called so because this type of experiment has not met the requirements such as how experiments that can be said to be scientific follow certain rules. In this study, experimental research methods were used to examine the physical motor abilities of AUD children by using learning media in the form of unique educational game tools in Royhan Mekar Galih Purwakarta Kindergarten.

Development Model

In this study, quantitative research was conducted using the pre experimental design method of the one group pretest posttest type. Arikunto (2010: 124) said that one group pretest-posttest design is a research activity that gives an initial test (pretest) before being given treatment, after being given treatment, then gives a final test (posttest). After seeing this understanding, it can be concluded that the results of the treatment can be known more accurately because it can compare with the situation before and after treatment. The use of this design is adjusted to the objectives to be achieved, namely to determine the fine motor skills of children before and after and after being given treatment. This one group pretest-posttest design consists of group A consisting of 10 children who have been determined. In this design, two tests are carried out, namely before being given treatment called pretest and after treatment called posttest. The research pattern of the one group pretest-posttest design method according to Sugiyono (2013: 75) is as follows:

Chart of One Group Pretest-Posttest Design Type

In this design, it was carried out twice, namely before and after being given experimental treatment. The test conducted before getting treatment is called a pre-test. Pretest were given to the experimental class (O1). After the pre-test is carried out, the treatment is given in the form of fine motor stimulation with unique clothing APE media (X), at the next final stage given posttests (O2).

Subject and Research Object

According to Sugiyono (2013: 117) states that population is a generalization area consisting of: objects / subjects that have certain qualities and characteristics set by researchers to study and then draw conclusions. Based on this, the population in this research activity is:

Ability to stimulate children's fine motor development

Based on the target is the population of AUD students in physical motor development.

Based on the Learning Component is the KI-KD of children's fine motor according to STPPA.

The object of research is early childhood children aged 4-5 years at RA Royhan. The number of child test subjects is 11 children.

Operational Variable

Sugiyono (2013: 60) states that research variables are basically anything in the form of anything that is determined by the researcher to study so that information about it is obtained, then conclusions are drawn. In this case, there are independent variables and dependent variables. Independent variables are variables that affect or cause changes or the emergence of dependent variables (bound). Meanwhile, the dependent variable is the variable that is affected or that is the result of the independent variable. In this study, the independent variables and dependent variables are as follows

1. The dependent variable in this study is the developmental achievement that refers to STPPA related to fine motor.
2. The independent variable is the use of media in the form of Educational Game Tools "Unique clothing" which is used as a tool for stimulating children's fine motor skills, such as:
 1. Opening and buttoning their own clothes
 2. Opening and closing the reseleting itself
 3. Simple sewing
 4. Opening and closing (pouch flaps that use velcro
 5. Opening and fastening snap buttons
 6. Inserting seeds into holes
 7. Attaching and tying laces / waistbands (belts)

Independent variables and dependent variables both play an important role in the research process, because research variables are properties and objects that must be studied and then conclusions can be drawn.

Data Collection Design and Research Instruments

In carrying out research activities, it is necessary to have techniques to achieve good and objective results. In order for the data to be collected properly, a data collection design is used in the form of a literature review, namely reading books related to the research to be carried out. Then the second is Observation, which is a data collection measuring tool used to determine individual behavior or the process of occurrence of an activity that is observed both in actual situations and in artificial situations. Furthermore, this technique aims to measure the knowledge skills and

abilities possessed by students. The type of test given is in the form of pre-test and post-test. This test is conducted to determine the fine motor skills of students who will be researched using APE Media in the form of Unique Clothing. The last is the Analysis Technique. The analysis technique is used to obtain the results of the investigation of students in the ability of children in their fine motor skills by using APE Learning media in the form of "Unique Clothing". This technique is used to analyze the difficulties of students in identifying children's fine motor skills. The data obtained in this study are qualitative data and quantitative data. Qualitative data is obtained from expert responses regarding the success and feasibility of learning media. Quantitative data is obtained from media feasibility expert scores, learning outcomes tests, and observations.

Research Instruments

Research instruments are related to data collection and data processing activities, because instruments are tools for collecting and processing data about the variables studied. Sugiyono (2013: 305) states that a research instrument is a tool used to measure observed natural and social phenomena. Specifically, all of these phenomena are called research variables. In this study, the authors used test instruments, namely preliminary and post-test questions. Arikunto (2010: 193) states that a test is a series of questions or exercises and other tools used to measure skills, knowledge, abilities or talents possessed by individuals or groups. As for the instrument in the form of observation, the observation technique in research is used to determine the situation or condition that will be the object of research. In this case is a child who has not been able to hold a pencil properly. This observation technique contains research on the attitude of students during the learning process. The following is an observation assessment format for students.

Grading Criteria

Assessment criteria are useful to facilitate teachers in giving grades. In addition, the assessment criteria present the requirements for achieving learner scores that are clearly presented.

Data Analysis Design

The data analysis design is used to facilitate the author in scoring the results of student performance. The weight of each assessment aspect has been carefully considered according to the weight of the question. The sum of the scores will be used as a reference for calculating the score. Learning assessment analysis can be obtained from the calculation of pretest and posttest scores. The acquisition of pretest and posttest scores is carried out in several stages. The initial stage is in the pretest activity, and the final stage is in the posttest activity. After the trial took place, it was used clearly, and the data was obtained using the research methods and techniques that had been chosen. The design of data analysis of pretest and posttest scores is as follows.

Hypothesis Test

In Chapter 1, it has been explained about several hypotheses underlying this research. Hypothesis testing serves to prove the hypothesis of the hypothesis that has been determined. And the test calculations can be done as follows:

Calculating the mean of the difference in pretest and posttest results. 1)
Calculating the mean of prates

$$M_x =$$

Description:

M_x = Mean Score of Prates

$\sum F_x$ = Total Score Acquisition of All Students

N = Number of Students

2) Calculating the post-test mean

$$M_y =$$

Description:

M_y = Post-test Mean Value

$\sum f_x$ = Total Score Acquisition of All Students

N = Number of Students.

calculating the post-test mean

$$M_y =$$

Description:

M_y = Post-test Mean Value

$\sum f_x$ = Total Score Acquisition of All Students

N = Number of Students

Calculating the mean of the difference between the mean of the pretest and posttest results (M_d)

The mean of the mean difference between the results of the pretest and posttest (M_d) learning to identify children's fine motor development abilities at RA Royhan with APE in the form of Unique clothing in 2023 as follows:

$$M_d = \frac{\sum d}{n}$$

Description:

M_d = Mean of the derivation of the results of prates and postates

$\sum d$ = The sum of the difference from the mean of the results of the pre-test and post-test

N = Number of Students

Hypothesis testing is carried out to prove the success rate of fine motor learning in children by using a unique clothing model. Hypothesis testing involves the calculation of pre and post-test data. The conclusion is, if $t_{count} > t_{table}$, the hypothesis is accepted while if $t_{count} < t_{table}$, the hypothesis is rejected.

Research Results and Discussion

Before the research was conducted, several stages of development were carried out, namely in the form of needs analysis, planning, making initial products, revising learning media, field trials, and final revision of learning media. Data from validation

results from material experts and media experts. The data from the material expert validation obtained a score of 33 with an average value of 3.3 can be categorized as "sufficient". The data from the media expert validation obtained a score of 40 with an average value of 4 can be categorized as "good", and is suitable for use to collect data with revisions according to the suggestions for APE media Unique Clothing that has been validated by experts is then tested. This trial was conducted on 11 children of group A RA Royhan on May 5, 2023 - May 10, 2023. Data Analysis of Learning Test Results with Unique Clothing media

This learning outcome data was obtained by conducting pretest and posttest trials in the form of assessment instruments according to indicators of coordination between eyes and fingers in children aged 4-5 years. Pretest data on individual percentage is obtained.

Before conducting research, researchers carried out development stages, namely needs analysis, planning, making initial products, revising learning media, field trials, and final revision of learning media. Data from validation results from material experts and media experts. The data from the material expert validation obtained a score of 33 with an average value of 3.3 can be categorized as "sufficient". Data from media expert validation results obtained a score of 40 with an average value of 4 can be categorized as "good", and is suitable for use to collect data with revisions according to suggestions Matching Box media that have been validated by experts are then tested. This trial was conducted on 11 children of group A Hidayatul Islamiyah Kindergarten on July 5, 2023 - July 9, 2023. Data Analysis of Learning Test Results with APE Media in the form of unique clothing.

CONCLUSION

APE Learning Media in the form of Unique Clothing to improve children's coordination skills (coordination between eyes and hands) for children aged 4-5 years was developed using the research and development method. Data from expert judgment validation results from 2 validators, namely material experts and media experts. Data from material expert validation results obtained a score of 33 with an average value of 3.3 can be categorized as "sufficient". Data from media expert validation results obtained a score of 40 with an average value of 4 can be categorized as "good", and is suitable for use to collect data with revisions according to suggestions.

The results of observations before being given stimulation with media in the form of unique clothing APE, 8 children were included in the category of developing as expected and 3 children were in the category of starting to develop in fine motor skills in children aged 4-5 years which included indicators of making vertical, horizontal, left / right curved, left / right sloping, and circles, tracing shapes, coordinating eyes and hands to perform complex movements, performing manipulative movements to produce a shape using various media and expressing themselves by creating art with an overall assessment score of 35.05.

From the data obtained after the trial was calculated using the percentage of success of students classically, resulting in 72.7% can be categorized as "Developing as expected" with a total of 8 children and 27.3% of children categorized as "Starting to Develop" totaling 3 children. Observation Results of Learning Activities with APE Media in the form of unique clothing.

Data after being given stimulation with APE media in the form of unique clothing, there are 3 children included in the category of developing very well, 7 children are included in the category of developing as expected and 1 child is in the category of starting to develop. The data obtained is calculated using the percentage of success of students classically so as to produce 90.9% can be categorized as "Developing Very Well" with a total of 10 children and 9.1% of children categorized as "Starting to Develop" totaling 1 child.

Based on the results of APE media research in the form of unique clothing to improve children's fine motor skills, it can be concluded that the media is Valid and Effective for APE Media Development in the form of unique clothing for children aged 4-5 years at RA Royhan Purwakarta.

REFERENCES

- Albrecht, E., & Chin, K. J. (2020). Advances in regional anaesthesia and acute pain management: A narrative review. *Anaesthesia*, 75(S1). <https://doi.org/10.1111/anae.14868>
- Arora, S., Singh, H., Sharma, M., Sharma, S., & Anand, P. (2019). A New Hybrid Algorithm Based on Grey Wolf Optimization and Crow Search Algorithm for Unconstrained Function Optimization and Feature Selection. *IEEE Access*, 7, 26343–26361. <https://doi.org/10.1109/ACCESS.2019.2897325>
- Bai, B., Guo, Z., Zhou, C., Zhang, W., & Zhang, J. (2021). Application of adaptive reliability importance sampling-based extended domain PSO on single mode failure in reliability engineering. *Information Sciences*, 546, 42–59. <https://doi.org/10.1016/j.ins.2020.07.069>
- Caniëls, M. C. J., Chiocchio, F., & Van Loon, N. P. A. A. (2019). Collaboration in project teams: The role of mastery and performance climates. *International Journal of Project Management*, 37(1), 1–13. <https://doi.org/10.1016/j.ijproman.2018.09.006>
- Chen, Y., Zhong, H., Wang, J., Wan, X., Li, Y., Pan, W., Li, N., & Tang, B. (2019). Catalase-like metal–organic framework nanoparticles to enhance radiotherapy in hypoxic cancer and prevent cancer recurrence. *Chemical Science*, 10(22), 5773–5778. <https://doi.org/10.1039/C9SC00747D>
- Gao, Z., Dang, W., Wang, X., Hong, X., Hou, L., Ma, K., & Perc, M. (2021). Complex networks and deep learning for EEG signal analysis. *Cognitive Neurodynamics*, 15(3), 369–388. <https://doi.org/10.1007/s11571-020-09626-1>
- Golden, T. D., & Gajendran, R. S. (2019). Unpacking the Role of a Telecommuter's Job in Their Performance: Examining Job Complexity, Problem Solving, Interdependence, and Social Support. *Journal of Business and Psychology*, 34(1), 55–69. <https://doi.org/10.1007/s10869-018-9530-4>

- Hassan, M. H., Houssein, E. H., Mahdy, M. A., & Kamel, S. (2021). An improved Manta ray foraging optimizer for cost-effective emission dispatch problems. *Engineering Applications of Artificial Intelligence*, 100, 104155. <https://doi.org/10.1016/j.engappai.2021.104155>
- He, J., Baxter, S. L., Xu, J., Xu, J., Zhou, X., & Zhang, K. (2019). The practical implementation of artificial intelligence technologies in medicine. *Nature Medicine*, 25(1), 30–36. <https://doi.org/10.1038/s41591-018-0307-0>
- Hu, L., He, S., Han, Z., Xiao, H., Su, S., Weng, M., & Cai, Z. (2019). Monitoring housing rental prices based on social media: An integrated approach of machine-learning algorithms and hedonic modeling to inform equitable housing policies. *Land Use Policy*, 82, 657–673. <https://doi.org/10.1016/j.landusepol.2018.12.030>
- Low, E. S., Ong, P., & Cheah, K. C. (2019). Solving the optimal path planning of a mobile robot using improved Q-learning. *Robotics and Autonomous Systems*, 115, 143–161. <https://doi.org/10.1016/j.robot.2019.02.013>
- Penconek, T., Tate, K., Bernardes, A., Lee, S., Micaroni, S. P. M., Balsanelli, A. P., De Moura, A. A., & Cummings, G. G. (2021). Determinants of nurse manager job satisfaction: A systematic review. *International Journal of Nursing Studies*, 118, 103906. <https://doi.org/10.1016/j.ijns.2021.103906>
- Peng, H., Wang, H., Du, B., Bhuiyan, M. Z. A., Ma, H., Liu, J., Wang, L., Yang, Z., Du, L., Wang, S., & Yu, P. S. (2020). Spatial temporal incidence dynamic graph neural networks for traffic flow forecasting. *Information Sciences*, 521, 277–290. <https://doi.org/10.1016/j.ins.2020.01.043>
- Pfattheicher, S., Nielsen, Y. A., & Thielmann, I. (2022). Prosocial behavior and altruism: A review of concepts and definitions. *Current Opinion in Psychology*, 44, 124–129. <https://doi.org/10.1016/j.copsyc.2021.08.021>
- Song, J., She, J., Chen, D., & Pan, F. (2020). Latest research advances on magnesium and magnesium alloys worldwide. *Journal of Magnesium and Alloys*, 8(1), 1–41. <https://doi.org/10.1016/j.jma.2020.02.003>
- Van Doren, J., Arns, M., Heinrich, H., Vollebregt, M. A., Strehl, U., & K. Loo, S. (2019). Sustained effects of neurofeedback in ADHD: A systematic review and meta-analysis. *European Child & Adolescent Psychiatry*, 28(3), 293–305. <https://doi.org/10.1007/s00787-018-1121-4>
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118–144. <https://doi.org/10.1016/j.jsis.2019.01.003>
- Wang, F., Wang, H., Wang, H., Li, G., & Situ, G. (2019). Learning from simulation: An end-to-end deep-learning approach for computational ghost imaging. *Optics Express*, 27(18), 25560. <https://doi.org/10.1364/OE.27.025560>
- Wang, S., Chen, X., & Szolnoki, A. (2019). Exploring optimal institutional incentives for public cooperation. *Communications in Nonlinear Science and Numerical Simulation*, 79, 104914. <https://doi.org/10.1016/j.cnsns.2019.104914>
- Yang, Z., Yu, W., Liang, P., Guo, H., Xia, L., Zhang, F., Ma, Y., & Ma, J. (2019). Deep transfer learning for military object recognition under small training set condition. *Neural Computing and Applications*, 31(10), 6469–6478. <https://doi.org/10.1007/s00521-018-3468-3>
- Zhang, Y., & Jin, Z. (2020). Group teaching optimization algorithm: A novel metaheuristic method for solving global optimization problems. *Expert Systems with Applications*, 148, 113246. <https://doi.org/10.1016/j.eswa.2020.113246>

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