Developing PETTLEP Imagery Model to Improve Self-Efficacy of Karate Athletes
Desarrollo del modelo de imágenes PETTLEP para aumentar la autoeficacia en atletas de karate

Candra Widyastuti*, Furqon Hidayatullah*, Sapta Kunta Purnama*, Febriani Fajar Ekawati*, **Muhammad Hidayat,
Kumala Windya Rochmani***, Trisnar Adi Prabowo***, Wahyu Dwi Yulianto***
*Sebelas Maret University (Indonesia), **Ahmad Dahlan University (Indonesia), ***Yogyakarta State University
(Indonesia)

Abstract. This study aims to develop the PETTLEP Imagery training model to improve self-efficacy of karate athletes. It is a research and development which used ADDIE model. The development of this training model involved four expert lecturers in sport psychology and coaching science as validators. The sample was 59 karate athletes aged 20.2 ± 3.5 with 7.8 ± 8.4 years of training experience, which were grouped for small-scale, large-scale, and effectiveness tests. The results of this study validated this training program using the Aiken V formula with a value of 0.880 so that the program was declared valid. Small-scale trials on 12 karate athletes showed a feasibility level of 80%, and large-scale trials on 30 athletes showed a feasibility level of 86%. Then, the effectiveness test using the t-test on 17 athletes showed a significance value of $0.000<0.05$ and t of 4.284. Thus, PETTLEP Imagery has a significant and positive effect on self-efficacy of karate athletes. In conclusion, the PETTLEP Imagery model has substantial implications for improving the self-efficacy of karate athletes in various ages and skill levels. From the results, it is expected that this study can provide insight into academics, coaches, and especially athletes in terms of providing appropriate, effective, and efficient training programs. Further studies need to explore the effect of PETTLEP Imagery on athletes' psychological and performance aspects.
Keywords: PETTLEP Imagery, Self-Efficacy, Karate

Resumen. El propósito de este estudio es desarrollar un modelo de entrenamiento PETTLEP Imagery sobre la autoeficacia en atletas de karate. Este tipo de investigación es la investigación y el desarrollo con el modelo ADDIE. El desarrollo de este modelo de formación ha contado con la participación de 4 profesores expertos en psicología del deporte y ciencias del coaching como validadores. La muestra es de 59 atletas de karate de $20,2\pm3,5$ años y $7,8\pm8,4$ años de experiencia en entrenamiento que se agruparán para ensayos a pequeña escala, ensayos a gran escala y ensayos de efectividad. El resultado de este estudio es la validación de este programa de ejercicios mediante la fórmula de Aiken V con un valor de 0,880, de forma que el programa es declarado válido. Los ensayos a pequeña escala en 12 atletas de karate mostraron una tasa de viabilidad del 80%, los ensayos a gran escala en 30 atletas mostraron una tasa de viabilidad del 86%. A continuación, la prueba de efectividad mediante la prueba t en 17 atletas mostró un valor de significancia de $0,000<0,05$ y t 4,284. Por lo tanto, existe una influencia significativa y positiva en las imágenes de PETTLEP en la autoeficacia de los atletas de karate. La conclusión es que el modelo PETTLEP Imagery tiene fuertes implicaciones en la mejora de la autoeficacia de los atletas de karate de todos los niveles de edad y habilidad. Las recomendaciones de los resultados de este estudio pueden proporcionar información sobre los académicos, los entrenadores y, especialmente, los atletas a la hora de proporcionar programas de entrenamiento adecuados, eficaces y eficientes. Nuevos estudios sobre la importancia de la investigación de PETTLEP Imagery sobre aspectos psicológicos y rendimiento de los atletas.
Palabras clave: PETTLEP Imágenes, Autoeficacia, Karate

Introduction

Self-efficacy is a belief in athletes' ability to perform tasks or actions needed to achieve achievements. Self-efficacy can help athletes determine the extent to which effort will be exerted in an activity despite obstacles (Romero et al., 2022; Miralles et al., 2023). Self-efficacy is something that athletes need in facing every match because, with self-efficacy, athletes will find it easier to reach their best ability (Mercader-Rubio et al., 2023). Combat sport is a type of sport that requires self-efficacy. Combat sports require physical contact from two participants with the same weight to compete with each other to earn more prominent points and defeat the opponent with takedown (Prabowo et al., 2024). Therefore, self-efficacy in combat sports is very necessary. One of the combat sports that requires self-efficacy is karate (Khodabandelou & Salehian, 2023). Ideally, an athlete who has self-efficacy abilities will be aware of his abilities and then will increase these abilities in each training so that he will reduce anxiety about facing competition

(Hernández et al., 2023; Setiawan et al., 2023; Hatami, 2023). However, in fact, many karate athletes do not understand how to train self-efficacy.

The role of self-efficacy in combat sports is interesting to analyze further because there are infrequent scientific publications related to it. Previous research explains that self-efficacy as a mediator can strengthen the effect of cognitive training strategies on psychological strength and skills in 44 combat sport practitioners (Slimani & Chéour, 2016). Other findings from self-efficacy and taekwondo are also reported, such as that taekwondo training can improve self-efficacy in children aged 10-12 (Cho et al., 2017). Then, mental training can also improve self-efficacy in ten junior taekwondo athletes compared to athletes who have never received mental training (Fajrika & Aulia, 2020). Another study comparing the level of aggressiveness based on self-efficacy of judo athletes who trained for five years with athletes from team sports reports that experienced judo athletes tend to have lower aggressiveness, openness, honesty and humility than athletes from team sports (Stanković et

al., 2022). Psychological toughness and self-efficacy also play an essential role in kicking for 305 combat sports athletes (Khodabandelou & Salehian, 2023). In conclusion, those studies explain the importance of training mental toughness and self-efficacy for maximum performance. Then, the results of discussion from other studies show that self-efficacy has an indirect relationship with motivation, anxiety and performance of athlete (Mandan et al., 2024; Juita et al., 2024; Wijayanti et al., 2024; Sridana et al., 2024).

To obtain a maximum performance, athlete needs to increase self-efficacy training. Thus, a training model specific karate is needed. The results of previous studies show that imagery training is more widely and effectively applied to all types of sports that suppress self-efficacy (Sato et al., 2017; Zach et al., 2018; Fazel et al., 2022; Volgemute et al., 2023; Singleton & McAllister-Deitrick, 2023). However, trained imagery training tends to only imagine during matches or imagine techniques and tactics. Therefore, it is necessary to develop an effective imagery training model to increase self-efficacy in karate athletes. Until now, an imagery training model has turned out to be more effective than the existing imagery training in general, namely PETTLEP Imagery. PETTLEP combines physical, environmental, timing, task, learning, emotion, and perspective (Lu & Xu, 2023). The fundamental difference between the approach using the PETTLEP model and the imagery method is that imagery exercise is considered separate from physical exercise. However, the PETTLEP model provides a concept of physical and imagery exercise as mutually supportive factors (Morone et al., 2022). Previous research reports that PETTLEP Imagery training for four months improved the service of beach volleyball athletes (Filgueiras, 2017). PETTLEP Imagery also increases the self-efficacy of 100-meter sprinter athletes (Wulandari & Jannah, 2018). In football, a study also reports that PETTLEP Imagery training is very effective in improving the basic skills of novice football players aged 14.65 (Norouzi et al., 2019). The combination of PETTLEP Imagery training with service-specific training for three days per week in 12 weeks is explained to improve the technical quality of pre-junior tennis athletes (Cherappurath et al., 2020). Then, PETTLEP Imagery training three times in four weeks also influences sport performance, confidence, and anxiety in four teams of high school basketball players in the Division II league (Chien et al., 2022).

Based on limited research studies, PETTLEP Imagery and self-efficacy play an essential role in athlete performance. However, from the evidence of previous studies, there has been no PETTLEP Imagery training method for self-efficacy in karate athletes. This study aims to develop the PETTLEP Imagery training model for self-efficacy in karate athletes. The findings of this study were to create a training model that passed expert validation in the field of sports psychology and then tested the effectiveness of karate athletes directly. The importance of this study is that until now, mental and physical training in karate athletes has been carried out separately. Thus, developing the PETTLEP Imagery training model can increase the self-efficacy of karate athletes, which will later impact achievement performance.

Methods

Research Design

The research carried out is included in the type of research and development (R&D). This research procedure adapts the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and evaluation (Branch, 2010). ADDIE model was chosen because it is developed or arranged programmatically, and its sequence is systematic in problem-solving. In addition, the advantages of the ADDIE model can be revised at every stage. The ADDIE model is effective in developing exercise methods in sports science and physical education (Hartati et al., 2022; Yachsie et al., 2023; Dewanti et al., 2023; Fizi et al., 2023; Sepdanius et al., 2024). This research has been permitted with research permit number 246/UN27.11/PK.03.01/2024.

The first stage in ADDIE is Analysis, focusing on problems and potential through observation and interviews with athletes and coaches. The second stage is Design, focusing on the initial development of the PETTLEP Imagery training model. The third stage is Development, focusing on developing a validated model and the necessary advice from experts. Apart from that, the development stage also includes aspects of assessing the PETTLEP Imagery training model which will later be used in small group trials and large group trials. The fourth stage is Implementation, focusing on testing the feasibility of the PETTLEP Imagery training model. The fifth stage is Evaluation, focusing on testing the effectiveness of the PETTLEP Imagery training model in increasing the self-efficacy of karate athletes. Thus, at the Evaluation stage, athletes did a pretest and were given treatment in 16 meetings on Monday, Wednesday and Friday afternoons. Then, a posttest was carried out to measure their self-efficacy.

The difference of the Implementation stage and the Evaluation stage is that the Implementation stage aims to test the training model as suitable for the sport of karate. Meanwhile, the Evaluation stage aims to directly test whether the PETTLEP Imagery model is effective in increasing self-efficacy or not.

Research Sample

The population in this study consisted of karate athletes from the province of Yogyakarta. The sampling technique in this study used purposive sampling, where the sample had specific characteristics. The characteristics of athletes are: have at least been champions at the regional level, and the minimum belt level is DAN 1. The number of athletes involved was 59, aged 20.2±3.5 years, with 7.8±8.4 years of training experience. The 59 athletes were divided into 12 for small-scale trials, 30 for large-scale trials, and 17 for

effectiveness testing through pretest-posttest.

Then, this study also involved four lecturers as experts in assessing the PETTLEP Imagery exercise program and self-efficacy instrument model. The lecturer criterion is an expert in sports psychology and karate sports coaching. There are four lecturers in two qualifications: two with the professor title and two with doctoral education degree.

Self-Efficacy Instrument

In the instrument's preparation, the first stage was collecting materials based on previous research. In this study, it was adopted from two existing self-efficacy instruments. The instrument was the Endurance Sport Self-Efficacy Scale (ESSES) developed by (Anstiss et al., 2018) which refers to the Bandura et al (1999), and AA-SES (Aerobic Athlete Self-Efficacy Scale) theory developed by Setiawan et al (2023). The second stage was modifying and developing from the previous instrument, which was carried out with FGD (focus group discussion) with four expert lecturers. The FGD aims to adjust the statement items to athletes in karate sports.

Results

The results of this research report five stages of the research and development (RnD) model, namely ADDIE. The first stage is Analysis, the second stage is Design, the third stage is Development, the fourth stage is Implementation, ant the fifth stage is Evaluation.

Analysis Stage

The training model developed was a mental exercise to increase self-efficacy with the PETTLEP imagery training model. This training model was developed for beginner to senior-age karateka. According to the analysis of the needs obtained based on potential, problems, analysis, interview results, and direct observation, the following results were obtained: 1) Coaches who accompany athletes still lack knowledge related to training that can increase self-efficacy for athletes, 2) Self-efficacy training are often excluded from sports coaching practices during the training process, 3) Coaches have not been able to and have not been able to implement self-efficacy training program, 4) Coaches have a negative perspective on the role of sport psychologists.

Design Stage

Needs analysis was the beginning of determining the product development of the PETTLEP imagery training model to be carried out. Next, the needs analysis was adjusted by combining the PETTLEP Imagery theory with karate sports skills. Thus, the PETTLEP Imagery training model will be systematic and effective in increasing athletes' self-efficacy. The results of the developed model are presented in Table 1.

Table 1.
Needs Analysis

No	Component		Description
1	Physical	Objective	: Improving the physical fitness of karate athletes
		Activity	: Offensive and defensive training sessions
2	Environment	Objective	: Preparing athletes to compete in a match environment
		Activity	: Conducting training session in a place as similar as possible to the match conditions
3	Task	Objective	: Improving athletes' skills regarding focus and concentration in karate
		Activity	: A training game that simulates a match situation
4	Timing	Objective	: Developing sensitivity to time and quick response
		Activity	: A specific time-setting exercise to evaluate attacking and defending. Drill quick reaction to changes in match situation
5	Learning	Objective	: Improving athletes' capacity to learn and adapt
		Activity	: Mental stabilization sessions and visualizations of success. Video reflection and analysis to understand the learning process
6	Emotion	Objective	: Bringing up the same emotions as the actual condition
		Activity	: Exercise to bring up tension when chase down points at the last minute, overcome emotions and manage stress when face the match
7	Perspective	Objective	: Understanding the difference one feels between imagery (internal imagery) and imagery (external imagery)
		Activity	: In external imagery, the athlete can see himself through video/recording equipment, while in internal imagery, the athlete imagines as if he is doing a match

Development Stage

The development stage is when the draft has been compiled and validated by the expert. Two karate experts and Two sport psychology.

Table 2.
Validation Results on Assessment Aspects for the PETTLEP Imagery Program

No	Aspect	Validator				Σs	V	Description
		1	2	3	4			
	Materials							
1	The material presented is suitable for the technique to practice	5	5	5	5	16	1	Very High
		4	4	4	4			
2	The material presented is based on the needs of athletes	5	5	4	5	15	0.9375	Very High
		4	4	3	4			
3	The material on the training model does not cause injury to athletes	5	5	5	5	16	1	Very High
		4	4	4	4			
4	Material on the variable exercise model	5	5	4	5	15	0.9375	Very High
		4	4	3	4			
5	The material presented is by the Stages of the	5	5	5	5	16	1	Very High

	PETTLEP Imagery training model	4	4	4	4			
6	The material presented is suitable to be used to improve athlete's self-efficacy	5	5	5	5	16	1	Very High
		4	4	4	4			
7	The material presented is according to karate standards and guidelines	5	5	5	4	15	0.9375	Very High
		4	4	4	3			
	Training Program							
8	The training program used is suitable with the purpose of training	5	5	4	5	15	0.9375	Very High
		4	4	3	4			
9	The training program is based on the needs of athletes	5	5	4	5	15	0.9375	Very High
		4	4	3	4			
10	The training program is according to athlete's initial fitness level, preference and mental condition	5	5	4	5	15	0.9375	Very High
		4	4	3	4			
11	Training program is suitable with the PETTLEP Imagery stages	5	5	5	5	16	1	Very High
		4	4	4	4			
12	The selection of training forms in the training program is interesting for athletes	5	5	4	5	15	0.9375	Very High
		4	4	3	4			
13	The selection of the form of training in the training program includes the safety and mental health factors of athletes	5	5	5	5	16	1	Very High
		4	4	4	4			
14	Training program can be effectively implemented in a karate practice environment.	5	5	5	5	16	1	Very High
		4	4	4	4			

Table 2 above shows the validation results of four experts on the training model analyzed using the Aiken V method (Figure 1). The scores of each validator for each item are summed and calculated using the Aiken V formula so that a V value is obtained in the table. Of the 14 validated items, all obtained a V value with a range between 0.9375 and 1. The entire item has a V value of 0.96875 if the average is searched. Based on Aiken V table (Aiken, 1985) with four validators, five options of scale, and error rate of 5%, the minimum V value for an item that is said to be valid is 0.88. Therefore, development can be considered valid to carry out. From the Aiken V validation results, this instrument was declared valid for use.

$$\text{V Aiken's: } \frac{\sum S}{n\,(c-1)}$$

S : $r - lo$

Lo : lowest rating score

C : highest rating score

r : the score given by the assessor

Figure 1. Aiken's Formula

Table 3.
Reliability Test Results

Cronbach's Alpha	N of Items
0.957	14

Based on the reliability test results, it was found that Cronbach's Alpha value was 0.957. Ghozali (2018) states that Alpha Cronbach's value is acceptable if it greater than 0.6. Because Cronbach's Alpha value in this study is 0.957, it can be concluded that the instrument is a reliable training model to be used. Alpha Cronbach's value is close to 1, indicating high internal consistency and reliability. Based on the results of validation and reliability tests, the assessment aspects consisting of material aspects and training program aspects were declared suitable for use to assess the PETTLEP Imagery training model for karate athletes. This instrument will also be used for small scale trials and large group scale trials.

Implementation Stage

A small-scale trial was done on 12 athletes, and a large scale trial was done on 30 athletes. The instrument used to assess the PETTLEP Imagery training program is the instrument in Table 2.

Small-scale Trial

Small-scale trial conducted on 12 athletes. It was used to understand and identify the advantages, disadvantages, and effectiveness of development when applied to athletes.

Table 4.
Small-scale Trial

Small-scale Trial				
Athlete	Total	Maximum Score	Percentage	Category
1	83	100	83	Very Feasible
2	80	100	80	Feasible
3	78	100	78	Feasible
4	79	100	79	Feasible
5	83	100	83	Very Feasible
6	84	100	84	Very Feasible
7	78	100	78	Feasible
8	85	100	85	Very Feasible
9	84	100	84	Very Feasible
10	70	100	70	Feasible
11	80	100	80	Feasible
12	81	100	81	Very Feasible
Average			80	Feasible

The value of each item is summed, and then the total results are converted into the appropriate category. Based on the information in Table 4, it can be concluded that a small-scale trial on twelve athletes was assessed as feasible for use, with a percentage of 80%.

Large-scale Trial

The steps taken in large-scale trial were similar to those

in small-scale trial. The only difference is that there are only a lot of trial athletes and test venues. The subjects used were 30 karate athletes.

Table 5.
Large-scale Trial

Large-scale Trial				
Athlete	Total	Maximum Score	Percentage	Category
1	93	100	93	Very Feasible
2	94	100	94	Very Feasible
3	97	100	97	Very Feasible
4	80	100	80	Feasible
5	89	100	89	Very Feasible
6	80	100	80	Feasible
7	81	100	81	Feasible
8	81	100	81	Feasible
9	91	100	91	Feasible
10	81	100	81	Feasible
11	95	100	95	Feasible
12	98	100	98	Feasible
13	78	100	78	Feasible
14	69	100	69	Feasible
15	88	100	88	Very Feasible
16	74	100	74	Feasible
17	88	100	88	Very Feasible
18	81	100	81	Very Feasible
19	96	100	96	Very Feasible
20	88	100	88	Very Feasible
21	86	100	86	Very Feasible
22	86	100	86	Very Feasible
23	91	100	91	Very Feasible
24	85	100	85	Very Feasible
25	88	100	88	Very Feasible
26	85	100	85	Very Feasible
27	86	100	86	Very Feasible
28	82	100	82	Very Feasible
29	86	100	86	Very Feasible
30	91	100	91	Very Feasible
	Rata rata		86	Very Feasible

The results of the assessment of the items are summed, and the total value is converted to determine the category. Table 5 above shows that the results of large-scale trial for 30 karateka athletes show a percentage of 86%. These results show that the developed training model is feasible to use. Compared to the results of small-scale trial, the percentage of this results increased by 6%.

Evalutation Stage
This evaluation stage is the final stage in the research and development model (ADDIE). Thus, there is a need for effectiveness tests in the form of pretest and posttest on the PETTLEP Imagery training model to increase self-efficacy. The instrument for measuring self-efficacy uses a questionnaire with a scale of five. Statistical analysis to see the effect of training uses the t test because it only focuses on one dependent variable, namely self-efficacy. Pretest - posttest was done on 17 athletes.

Before carrying out the t test, prerequisite tests was carried out, namely normality test and homogeneity test. Based on Table 6, the normality test using Shapiro-Wilk shows a pretest value of sig. 235 (>0.05) posttest value sig. 394 (>0.05), so the data is normally distributed. Then the homogeneity test based on table 7 shows sig. 361 (>0.05) means the data comes from the same population. After the data shows normal and homogeneous, the t test then was done.

Table 6.
Normality Test

Normality Test				
Variable	Test	Shapiro-Wilk		
		Statistic	Df	Sig.
Self-Efficacy	Pretest	0.729	16	0.235
	Posttest	0.786	16	0.394

Table 7.
Homogeneity Test

Homogeneity Test of Variances				
	Levene Statistic	df1	df2	Sig.
Self-Efficacy	pretest-posttest	0.860	2	32	0.361

Table 8.
Paired Sample test

Paired Sample Test							
		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	pretest - posttest	2.34286	3.23531	0.54687	4.284	34	0.000

Based on the t-test results in the Table 6 above, the significance value of sig. < 0.005 can be identified, and it shows 4.285. Thus, the significance value is 0.000, and this result shows a significant difference, and the direction of the relationship is positive. Thus, the PETTLEP imagery training model used effectively improves self-efficacy both for beginners and seniors.

Discussion

This study aims to design a PETTLEP imagery model that can improve the self-efficacy of karateka from beginners to seniors. This model specifically focuses on an in-depth understanding of the specific needs of karate athletes before being designed according to the principles of PETTLEP imagery. Imagery, as described by Cumming and Ramsey (2009), is a mental experience that mimics real situations by involving sensory functions in the absence of actual perception.

This model is developed by combining imagery principles with the PETTLEP model. As a fundamental difference from traditional imagery methods, the PETTLEP model integrates imagery exercises into physical exercise, making it a mutually supportive factor (Smith & Wakefield, 2015). PETTLEP stands for Physical, Environment, Task, Timing, Learning, Emotion, and Perspective, where the PETTLEP imagery exercise model was developed by integrating clear objectives for each model component.

The results show that the PETTLEP imagery exercise model effectively improved the self-efficacy of karate athletes from beginners to seniors. It is supported by the significance of the pretest-posttest, which is in line with the findings of previous studies that showed a comparable level of effectiveness between PETTLEP imagery exercises and conventional physical exercises (Wright & Smith, 2007). The results of this study are from previous research reports

that PETTLEP Imagery effectively improves skills in beach volleyball, youth football, and tennis (Filgueiras, 2017; Norouzi et al., 2019; Cherappurath et al., 2020). PET-TLEP Imagery also specifically increases self-efficacy in sprinter athletes (Wulandari & Jannah, 2018), and can improve athlete performance, confidence, and anxiety in basketball athletes (Chien et al., 2022). The results of this study reveal a novelty that the PETTLEP Imagery training program has been developed for the sport of karate.

The effectiveness of the PETTLEP imagery model in improving karateka self-efficacy is understood through integrating the concepts of physical exercise and imagery. Through the pieces of mental images that are built, PET-TLEP imagery can create an internal experience that is close to the actual physical experience by the purpose of mental imagery practice (Holmes, 2001). The theory of "attention arousal" also explains that imagery can prepare sportsmen's physical and psychological performance, which in turn increases the self-efficacy and performance of athletes (Sheikh & Korn, 1994; Olsson, 2008). In addition, from the feedback of each meeting after the treatment process, karate athletes reported that they became more aware of the importance of psychological aspects in improving performance during the training process and facing the race. Athletes find it easier to make a plan and initial picture to deal with the situation to be lived. The athlete also feels ready to face the training process and more confident in his ability to undergo heavy training.

As an integral part of sports psychology, self-efficacy is defined as an individual's belief in his or her ability to carry out the necessary actions (Sham, 2017). It emphasizes the importance of motivation, cognition development, and the surrounding environment in increasing self-efficacy (Pajers Miftahun, 2009; Bandura, 2006; Ghufron & Nur, 2010). Thus, the PETTLEP imagery model has substantial implications in improving the self-efficacy of karateka of various ages and skill levels. an.

Conclusion

The product design developed is an imagery PETTLEP training model to improve the self-efficacy of beginners and seniors. This product is designed to provide a more profound experience in preparing karate athletes' mentality that can be used by coaches, practitioners, and karate athletes. Based on the instrument validation test, the Aiken V value was 0.9687, and the reliability value was 0.000. It can be concluded that the PETTLEP imagery model developed is valid and reliable. The results of small-scale tests on 12 karate athletes showed that the average self-efficacy achievement of several indicators submitted reached 80%. If categorized, then it is included in the category that is eligible for use. Furthermore, on a larger scale, tested on 30 athletes, it showed an average score of self-efficacy achievement of 86%. From the results of small and large-scale trials, there was an increase of 6%. The percentage increase shows a good increase in the self-efficacy of the karate

athlete. So, it can be concluded that the imagery PETTLEP training model to increase the self-efficacy of beginner to senior karate athletes is very feasible. The results of the effectiveness test conducted on 17 karate athletes show that the significance value of the t-test is 0.000. Thus, the PET-TLEP imagery model developed effectively increases the self-efficacy of beginner to senior of karate athletes.

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Datos de los/as autores/as y traductor/a:

Candra Widyastuti	Candrawidiastuti3@student.uns.ac.id	Autor/a
Furqon Hidayatullah	mohammadfurqon@staff.uns.ac.id	Autor/a
Sapta Kunta Purnama	saptakunta@staff.uns.ac.id	Autor/a
Febriani Fajar Ekawati	febriani@staff.uns.ac.id	Autor/a
Muhammad Hidayat	muhammad.hidayat@psy.uad.ac.id	Autor/a
Kumala Windya Rochmani	kumalawindya@uny.ac.id	Autor/a
Trisnar Adi Prabowo	trisnaradi.2022@student.uny.ac.id	Autor/a
Wahyu Dwi Yulianto	Wahyu525fikk.2022@student.uny.ac.id	Autor/a
Resna suci nurfalah	resnasucinurfalah@gmail.com	Traductor/a