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LdesV, computer-operated video: overcoming students' difficulties in understanding automotive starting system

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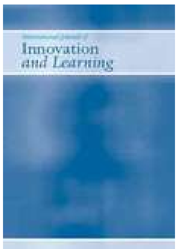

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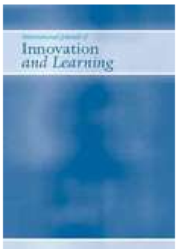

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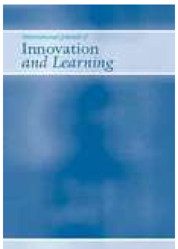

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Guest Editors: Dr. Adhi Kusumastuti, Dr. Dwi Widjanarko and Dr. Eko Supraptono

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Title: LdesV, computer-operated video: overcoming students' difficulties in understanding automotive starting system

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Abstract: The invisible flow of electric current in the automotive electrical system circuit becomes a major problem for students to learn how electrical systems work. To overcome these problems, visualisation of flow of electric current in automotive electrical circuit is necessary. In this study, short duration video was developed to visualise the flow of electric current and the video was applied during the learning process of automotive electrical system. The video was developed using DDD-E models and validated by some experts to assure that the video qualifies as a learning medium. The field trial was conducted through quasi-experimental design with single group pre-test-post-test design. This experiment was conducted to test the effectiveness of LdesV during learning process. The results showed that the students' mastery of the starting system increased and varied significantly compared with before using LdesV. Therefore, the use of LdesV in learning was proven effective.

Keywords: LdesV; learning by video; automotive electrical system; starting system; vocational education.

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LdesV, computer-operated video: overcoming students' difficulties in understanding automotive starting system

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1 Introduction

Vocational secondary school teachers are prepared to have the knowledge and skill in their field to be transferred to their students in the classroom, in the laboratory, or in the workshop. In the automotive field, teachers must master the entire system in a vehicle that includes the engine, power train, and electrical system. In the classroom learning, the electrical system is a system that is difficult to study because the electric current cannot be seen visually to ensure that the system works. Mastery of the automotive electrical system operation is basic knowledge for teachers or prospective teachers (Widjanarko et al., 2014). In another study, Widjanarko et al. (2016) state that the prospective automotive teacher faced difficulties to understand and explain the operation of the automotive electrical system. The mastery level was less than 50% and it was very far from the minimum requirement which was 70%. Based on the evaluation, the difficulty lies in how the system works (Budiyanto et al., 2014). One of the strategies to overcome this difficulty is to visualise the flow of current in the automotive electrical circuit. In this study, a computer was used to develop video which visualised the automotive electrical current circuit (Widjanarko et al., 2014).

The video can describe something that is not common and difficult to be duplicated. It is capable of displaying static and moving things, can depict the occurrence of form changes and temporary characteristic of an object, and can be inserted with animation to increase understanding (Harwood and McMahon, 1997).

The use of video can ease the complexity of the learning process, and enable a structured observation to be conducted from a different perspective. It increases the quality of the learning process (Krammer et al., 2006). The video is a powerful medium in e-learning. Interesting and consistent information can be given by video. In addition, the video allows students see a realistic view of events and actual objects through the motion picture while listening to the sound (Zhang et al., 2006).

Technology has become a very important part in education. Technology in education can be used to improve the process and quality of the learning process (Salleh and Laxman, 2014). Technology should be used in all learning activities, including in higher education that prepares future teachers vocational education. There have not been many studies on the implementation of video in the learning process in higher education institution. In addition, there are only few publications related to the student's perception about the video and its application in the classroom (Tiernan, 2015). Therefore, this article was aimed to review the implementation of the short duration video during the automotive electrical system learning process in higher education.

2 Video in classroom

Technology can be used to improve the learning process and can change the way teachers teach and the way students learn. The incorporation of information and communication technologies affects the quality of teach (Ang'ondi, 2013). One of the technologies that could potentially be used in the classroom is the video. Video can influence the thoughts and feelings of students (Berk, 2009). The video is also a useful tool to show the models and practical examples for students. It can improve the quality of learning, and puts students as the centre of learning (Tiernan, 2015). Repeated playback is an important aspect of video that allows students to repeat the material in the video outside the classroom (Toppin, 2011).

Several previous studies which also use video as a teaching companion have been conducted. Isiaka (2007) concluded that the video can make learning effective for both children and adults for a variety of subjects. Toppin (2011) also states that the video provides an important role in improving academic performance and memory. Learning process which is facilitated by media operated through a computer (including video) makes the students feel motivated (Keengwe and Hussein, 2014) and it has a positive effect on behaviour and achievement (Harwood and McMahon, 1997; Lee and Yuan, 2010). This motivation is also the most influential factor on learning outcomes (Lee and Yuan, 2010).

The video-based learning systems and training support the effectiveness of learning process. The students' learning outcomes and satisfaction levels are higher when they were taught in an e-learning environment using an interactive educational video than those who did not use the video (Zhang et al., 2006). Learning using multimedia and video provide the empirical foundation for the students to improve their understanding and a deeper memory (Berk, 2009). The use of digital video in learning has increased significantly. Educators can see something of value for students with the use of video containing teaching materials (Tiernan, 2015).

Berk (2009) states that there are eight stages of the use of video in the classroom, namely:

a taking a certain clip to illustrate a concept or principle

b preparing a special guideline for students or questions to discuss

c providing a brief explanation to strengthen the purpose

d playing a clip

e stopping the clip on a given impression to highlight a particular section or replay the clip

f allowing time for reflection about the clip

g conducting an active learning process to interact with questions, issues, or a specific concept in the clip

h a discussion about the questions in small or large groups.

Based on the above discussion, it can be concluded that teachers, educators, or prospective teachers must have the ability in the use of technology (such as computers) to facilitate the learning process. In this study, a computer was used to view video about automotive electrical systems. The use of computers could increase students' motivation because it displayed colourful pictures so that the learning process could be more interesting. The colourful presentation of the teaching material is indispensable for the students to make learning more enjoyable and they want to continue their study (Ang'ondi, 2013). Computers have given a global impact on the development of social and educational systems. Teachers play an important role in the utilisation of computers in schools as an educational system. Ability to teach using the computer is a very important factor in learning (Salleh and Laxman, 2014).

Having regard to the student's difficulties, especially difficulties in analysing the damage in starter system (Febriyono and Widjanarko, 2014) and learning about the operation of automotive electrical system as well as a literature review on the above, the study was aimed to:

1 develop LdesV as instructional videos that can visualise the flow of electric current in automotive electrical circuit

2 test the effectiveness of LdesV in learning activities.

3 Method

The automotive electrical system which became the focus of this study was the starting system video. The starting system video developed in this study consisted of the conventional and the reduction type of starting system. Broadly speaking, the video content included an introduction, the function of the starting system, components and functions, the starting system circuit, the starting system operation, and conclusion. The short video about the starting system was developed with the animation facility in Microsoft PowerPoint, and it was then recorded, edited, and transferred into a video. This short video by the researchers was termed as 'limited duration electrical system video

(LdesV)'. The video was used as a medium of learning to help students understand how the automotive electrical system works.

The video was developed with the development model of decide, design, develop, and evaluation (DDD-E) according to Ivers and Baron (2002). On the decide stage, it focused on the determination of the purpose and content of the LdesV; design stage determined the structure of LdesV; develop stage included programming, the process of making the video, and validating video content through expert assessment; evaluate stage assessed the design, process development, and the end result of the video. The LdesV implementation was conducted in several stages:

a preparing LdesV

b conducting the learning process on the starting system subject

c conducting pre-test

d conducting classroom learning process by utilising LdesV starting system

e implementing post-test

f analysing the data

g concluding the study.

This study used a quasi-experimental design with single group pre-test-post-test design. The control class and experimental class were not used in the study because it was difficult to ensure that the students in the control and experiment class would not interact after instructional hours were completed. Samples of this study were students of Automotive Engineering Education Study Program which took automotive electrical course totalling 35 people. Data collection instruments used in this study were:

a media expert and automotive electrical system expert validation sheet to assess the feasibility LdesV

b an essay test to measure students' understanding on the starting system materials before and after using LdesV in learning process.

The feasibility of the LdesV data were analysed and calculated into the score with a scale of 0 to 1 and compared with reference values validity. Data tenure system starter students were analysed using paired t-test to compare learning outcomes before and after using LdesV.

4 Result and discussion

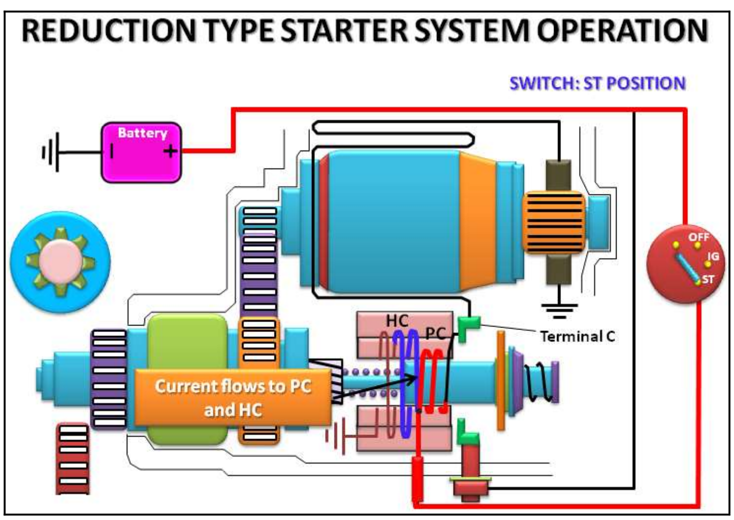
4.1 Automotive starting system LdesV

LdesV which has been developed was focused on the conventional and reduction starting system. The video content included an introduction to the starting system, the functions of the starting systems, components and functions of the starting system components, the starting system circuit, the operation of the starting system, and conclusions. LdesV could be operated using a PC or Laptop and LCD projector. Some examples of LdesV were shown in Figures 1, 2, and 3.

Figure 1 The initial display of LdesV (see online version for colours)

Figure 2 LdesV menu display (see online version for colours)

Figure 3 The example of LdesV display that describes the flow of electric current for starting system operation (see online version for colours)



The initial display of LdesV did not specifically reveal starting system material for LdesV was made by researchers because LdesV which was developed would be made for other automotive electrical system on the next project. The custom name of the starting system is placed in the options menu as shown in Figure 2.

On the menu, the user can choose the LdesV conventional or reduction starting system. In each selected type, the user can choose the 'voice' or 'silent'. The voice mode of LdesV would display the video with accompanying sound which describes every impression that appear on the screen. Therefore, the students can see and listen to the video description. In silent mode of LdesV, the display is not accompanied by sound descriptors. This option can be used by the user to train the ability to explain the starter system in accordance with the impressions appears. Users can explain what video is displayed according to the narrative. It aims to train the mastery of the starting system. One of the examples of LdesV starting system display is shown in Figure 3.

Before being used as a medium of learning, LdesV starting system was validated and evaluated by several experts. Based on the evaluation from the expert of automotive electrical material, the score was 0.95 on a scale of zero to one and it was confirmed to Bloom et al. (1981) found that this score is valid criteria.

4.2 Experiment result

LdesV was applied in the learning process of automotive electrical systems. Pre-test and post-test results showed that the students' learning outcomes increased after the implementation of LdesV. The average pre-test score was 53.29 and the post-test result was 75.94. The complete data of pre-test and post-test can be seen in Table 2.

Table 1 Data mastery of starting system

	Pre-test					
	SSF	*SSK*	*SSC*	*SMC*	*SSO*	*Avg*
Average	81.18	46.03	39.71	80.00	20.29	53.29
Max. score	100	90	100	100	80	
Min. score	20	0	0	60	0	
Median	80	30	0	90	0	
Modus	100	30	0	90	0	
Std. dev.	21.07	27.46	48.31	12.244	28.75	
	Post-test					
	SSF	*SSK*	*SSC*	*SMC*	*SSO*	*Avg*
Average	90.29	79.12	61.76	89.71	63.82	75.94
Max. score	100	100	100	100	90	
Min. score	0	40	0	70	0	
Median	100	90	90	90	70	
Modus	100	90	0	90	90	
Std. dev.	18.548	17.06	46.97	7.47	30.946	

Notes: SSF = starting system function, SSK = starting system components, SSC = starting system circuit, SMC = starter motor component, and SSO = starting system operation.

The mastery of automotive starting system, as described above, consists of five indicators, namely the ability to explain the starting system, the starting system components, the starting system circuit, the starting system components, and the starting system operation. According to the table above, it is clear that the average post-test score is higher than the score of the pre-test based on the five indicators that were tested. This shows that the LdesV starting system can improve the performance or student learning outcomes. If seen in Table 1, the highest increase of mastery of the starting system was in SSO understanding that the increase reached 215%. The increase in other indicators respectively was 72% at SSK, 56% in SSC, 12% at SMC, and 11% in SSF.

To check the significance of the difference between the average score of pre-test and post-test, t-test was conducted. The summary of the t-test results is shown in Table 2.

Table 2 The summary of t-test

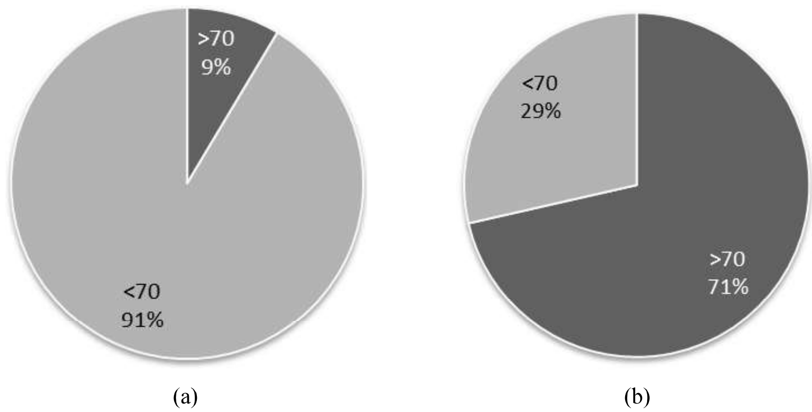
No.	*Data*	*n*	$\tilde{y}$	$\sum di2$	*t count*	*t table, significant level*		*Conclusion*
						1%	*5%*	
1	Pre-test	35	53.29	10591.61	3.94	2.386	1.666	Significantly different
2	Post-test	35	75.94	6705.19				

The data in Table 2 indicate that the result $t_{statistics}$ is greater than t_{table}. It means that there is a significant difference between the average score of pre-test and post-test. In other words, the use of LdesV automotive starting systems was effective in improving student learning outcomes in automotive starting system materials. The increase in general reached 22.66 points, or 42.52%. This increase is caused by the ability of LdesV starting system which can explain and visualise clearly and systematically about the starting systems, the starting system components, the starting system circuit, and the operation of the starting system. Therefore, this video can be used for automotive electrical system learning process, especially for strengthening starting system mastery. The results of the study were in line with Harwood and McMahon (1997) stating that the video can significantly improve behaviour and learning achievement compared to learning that does not use video. According to students, the video could give a positive impression as a good medium to use in learning.

As outlined in the beginning of this article, the level of mastery of automotive electrical systems must be > 70 (the range of 0 to 100). Before using LdesV, the mastery of students who achieved > 70 only 9% of the total number of students, and after the implementation of LdesV, the mastery of students who achieved > 70 increased to 71%. This shows that LdesV was really effectively in helping the students to understand the automotive starting systems. LdesV can be a solution to overcome the lack of media that can visually demonstrate and explain the flow of electrical current in the starting system in detail and systematically.

Based on data from the above, LdesV was very useful to facilitate understanding of the SSO = starting system operation, SSK = starting system components, and SSC = starting system circuit. For an explanation of the starter motor component SMC = and SSF = starting system function, LdesV did not contribute much for SMC and SSF because they are not difficult materials that the value pre-test was already high and did not differ significantly from the value of the post-test. However, overall student achievement improved significantly after the implementation of LdesV because the students were motivated and serious students to learn.

Figure 4 Percentage of students whose score > 70, (a) before the implementation of LdesV (b) after the implementation of LdesV



4.3 Discussion

LdesV has become a good video to improve students' mastery of the automotive electrical system learning material, especially the starting system. The increase occurred in all indicators of the starter system material. The video was able to enable students to observe with what they saw seriously. The use of video in the classroom also allows the students to relate to the activity of observation and discussion, and theory with practice (Krammer et al., 2006). Students' opinion about the use of the video as a tool for learning is video has a positive impact on how students associate with the learning material, the video gives a view, context, other example, and provides valuable learning opportunities (Tiernan, 2015).

The use of video in learning process is not new. The novelty of the video can lie on these aspects:

a the types of video formats

b the ease of use of technology in the classroom

c the use of multimedia during learning process can provide theoretical and empirical support as an effective learning tool (Berk, 2009).

Video can be used in various contexts of learning to change and add to the students' experience. Educators generally use video as activities in the classroom, where the video is seen together in a big group (Tiernan, 2015). Digital video can be one part in learning the most important because video can convey something essential about what is being learned (Anu et al., 2014).

The developments of information and communication technologies allow us to integrate video in the online learning system. It can help anyone to learn more easily at anytime and anywhere. In fact, according to Multisilta (2014), education and research communities are using video in the learning process and the internet is growing very rapidly. According to Tiernan (2015), the integration of video in the learning process enables better interaction between users or students. Students did not only use the video but also engage and interact with each other (Carter et al., 2014). Students who were in a learning environment that used technology felt the positive results of the study results. When a computer was used in the classroom, the students' attitudes toward the formation of self-concept and learning was consistently increasing (Keengwe and Hussein, 2014). The technology used in learning encouraged the students were more successful in learning in the classroom. In other words, the students' achievement can be better than students whose learning did not use technology (computers).

4.4 The possible usage for vocational education

Based on the study and discussion above, LdesV which was developed as an instructional video was suitable for the use in automotive electrical system learning process. It was based on the content validity and performance of LdesV which was very high. This video gave a significant influence in helping the prospective automotive teachers, especially on the starting system learning material. For prospective teachers of vocational schools in the automotive field, this video could be used to master the automotive electrical system that would be taught to students.

According Pavlova (2009), the vocational education aims to prepare students to get job training on specific skills that match the needs of the industry. Therefore, the prospective vocational school teacher must master the subject matter and skills to be taught to students. Teachers' competence (Skinner, 2005) includes the ability to conduct learning; having the knowledge, understanding and skills. Teachers must be able to demonstrate what should be studied to the students because demonstration is one of the suitable methods in the learning process of vocational education (Petrina, 2007).

5 Conclusions and recommendations

LdesV developed in this study was eligible to be used as a learning medium. It was based on the assessment of instructional media experts and automotive electrical system that can be categorised as very good. When LdesV was implemented during learning process, LdesV gave satisfactory results because the students' learning outcomes improved significantly. It can be concluded that that the video is effective in increasing mastery of the starting system. In connection with the above conclusion, educators or teachers can use the LdesV as an effective instructional medium for automotive starter system material which can provide convenience to students studying the automotive electrical systems.

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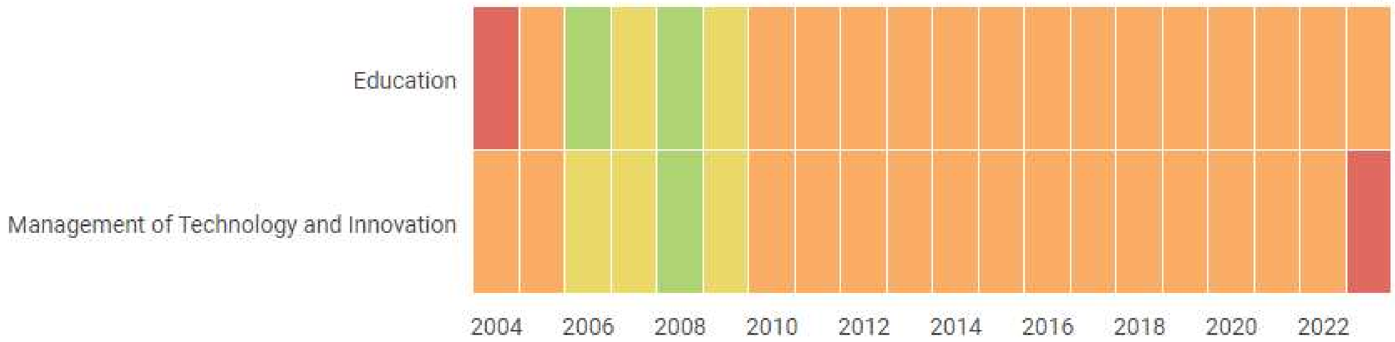

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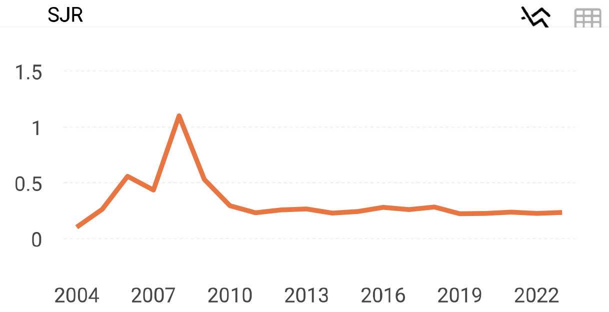
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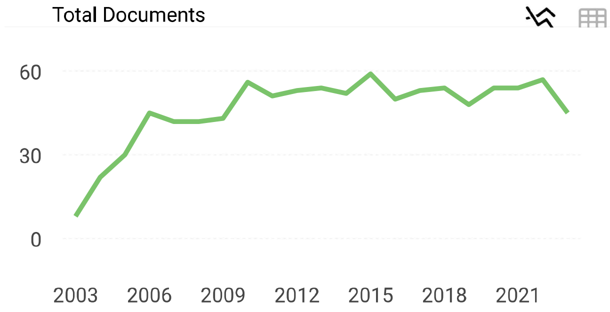
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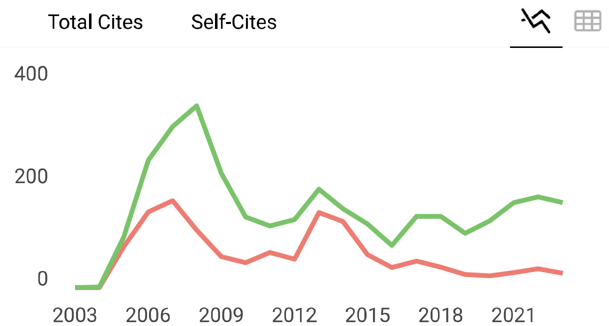
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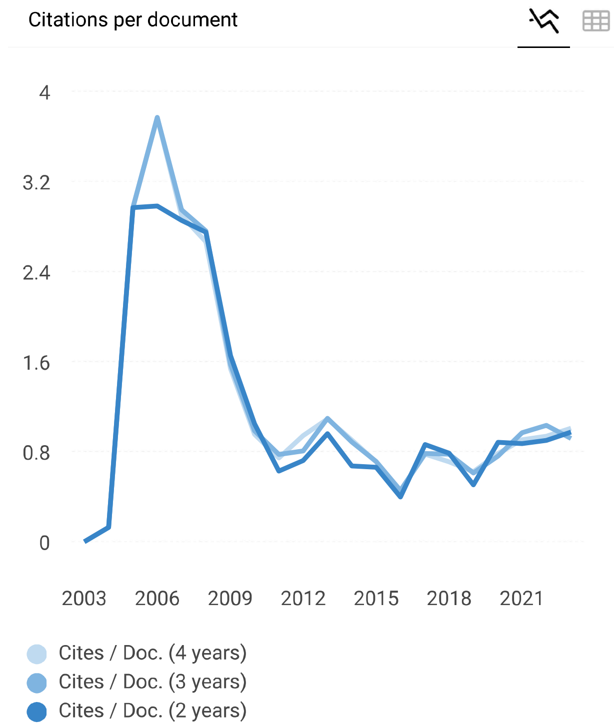
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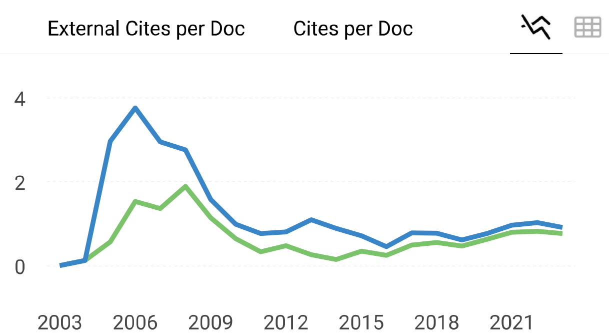
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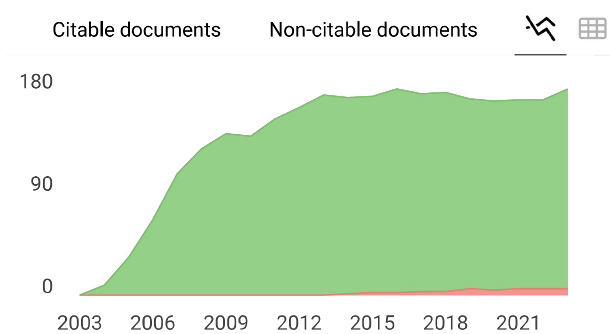
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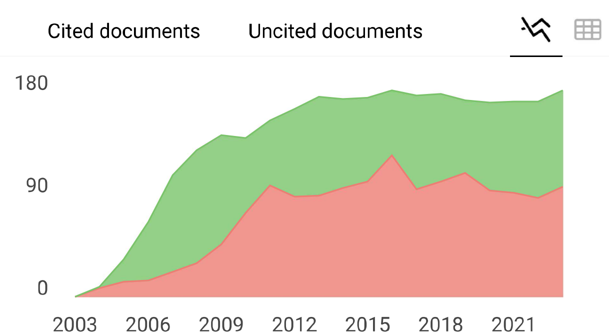
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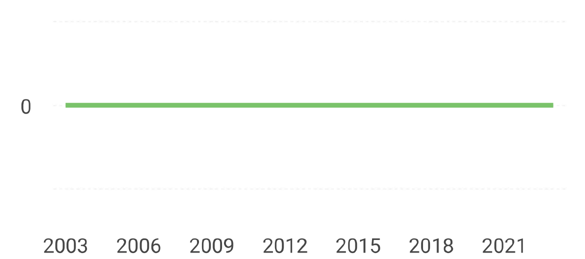

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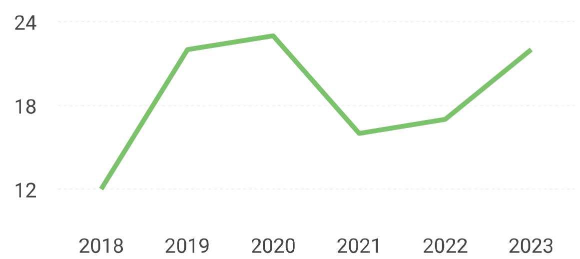

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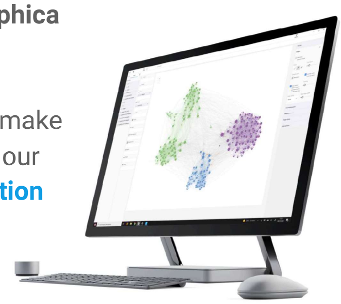

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