PIONEER AND INNOVATIVE RESEARCH IN EDUCATIONAL SCIENCES

All Sciences Academy

TREND AND ADVANCED STUDIES IN EDUCATIONAL SCIENCES

Editor
Prof. Dr. Yavuz DEĞİRMENCİ

Trend and Advanced Studies in Educational Sciences
Editor: Prof. Dr. Yavuz DEĞİRMENCİ

Design: All Sciences Academy Design
Published Date: July 2026
Publisher's Certification Number: 72273
ISBN: 978-625-8839-33-3

www.allsciencesacademy.com
allsciencesacademy@gmail.com

CONTENT

CONTEXT-BASED LEARNING AND THE REACT STRATEGY:
A Quasi-Experimental Study on Academic Achievement and Attitude in the Sixth-Grade "Transmission of Electricity" Unit

Latif GÜNEŞ[1]
Mustafa YILMAZLAR[2]

[1] Doctoral candidate, Sakarya University, Institute of Educational Sciences, Department of Mathematics and Science Education, Science Education, latifgunes16@gmail.com ORCID No: 0000-0002-9832-5553

[2] Prof. Dr.; Sakarya University, Institute of Educational Sciences, Department of Mathematics and Science Education, Science Education. myilmazlar@sakarya.edu.tr ORCID No: 0000-0003-0622-3355

This chapter is an original text that reorganizes, synthesizes, and expands upon the author's master's thesis (Sakarya University, Institute of Educational Sciences, 2022), adapted to the format of an academic book chapter.

ABSTRACT

The disconnect between classroom knowledge and everyday experience in science teaching is one of the most persistent obstacles to durable and meaningful learning. This chapter centers on the REACT strategy (Relating, Experiencing, Applying, Cooperating, Transferring), a concrete solution that the context-based learning approach offers to this disconnect. The discussion is woven around the findings of a quasi-experimental study that tested the effect of teaching the sixth-grade "Transmission of Electricity" unit through the REACT strategy on academic achievement, retention of learning, and attitude toward the course; however, rather than merely reporting these findings, the chapter situates them within a thematic synthesis of constructivist theory, context-based learning models, and the REACT literature. The findings show that the REACT strategy has a strong and consistent effect on academic achievement and short-term retention, while its effect on attitude is statistically significant but more modest in magnitude. The chapter interprets this pattern in relation to the conflicting attitude findings in the literature, offers concrete recommendations for classroom practice, and proposes a research agenda for testing context-based teaching in physics-based topics, one of the field's most conspicuous gaps.

Keywords: REACT strategy, context-based learning, constructivism, academic achievement, science education, transmission of electricity

1. INTRODUCTION: WHY DOES LEARNING WEAKEN WHERE CONTEXT IS LOST?

A student may recite the resistance formula in a circuit diagram from memory, yet the same student may be unable to explain why an extension cord at home heats up, or why an electrician uses cables of different thicknesses. One of the oldest and most persistent problems of science education lies precisely here: the disconnect between the knowledge produced inside the classroom and the experience lived outside it. Students can often give the "correct answer" without seeing what that answer corresponds to in the real world. This situation is a reminder that science teaching is not merely a transfer of concepts but also a process of meaning-making.

This chapter brings together two complementary responses that the literature on educational psychology and science education offers to this disconnect — constructivist learning theory and the context-based learning approach — within a single strategy, REACT (Relating, Experiencing, Applying, Cooperating, Transferring). The empirical ground of our discussion is a quasi-experimental study that tested the effect of teaching the sixth-grade "Transmission of Electricity" unit through the REACT strategy on student achievement, retention of learning, and attitude toward the course. Our aim here, however, is not to re-report that study, but to situate it within a broader theoretical and empirical discussion in order to generate knowledge that is transferable to both researchers and practicing teachers.

The topic of the transmission of electricity was not chosen for this discussion by accident. Concepts such as current, resistance, conductivity, and insulation, despite their high level of abstraction, are physical phenomena that constantly appear in everyday life, spanning a wide range of daily experience from household wiring to automotive electrical systems, from charging cables to household electrical appliances. This dual property — the coexistence of high abstraction with high everyday exposure — makes the topic a convenient laboratory for testing the effectiveness of context-based teaching strategies. Indeed, as we will show in later sections, the REACT strategy has mostly been tested in chemistry teaching in both the domestic and international literature, while its use in physics remains comparatively limited. The study addressed in this chapter contributes to that gap through a physics-based science topic.

The remainder of the chapter is organized as follows: the second section critically examines the theoretical line running from constructivism through context-based learning to the five steps of the REACT strategy. The third section presents the national and international research findings accumulated on the REACT strategy, not as a chronological list but as a thematic synthesis, and identifies the field's most notable knowledge gaps. The fourth section presents the methodological framework of the study, the fifth the findings, the sixth the dialogue these findings establish with the literature, the seventh the implications for classroom practice, and the final section the recommendations for future research.

2. THEORETICAL FRAMEWORK: THE LINE FROM CONSTRUCTIVISM TO REACT

2.1. Constructivist Learning Theory: The Nature of Knowledge That Cannot Be Transferred from Outside

The core claim of constructivism is simple yet radical: knowledge is not a ready-made package that can be transferred as-is from a teacher to a student; each learner reconstructs new knowledge through their own mental schemas, prior experiences, and social interactions. This view is not merely a psychological theory explaining learning as a concept; it also carries an epistemological stance on the nature of knowledge itself, assuming that knowledge does not exist as an objective, fixed reality independent of the individual, but is instead continually reproduced through the subject's active participation.

The three main branches of constructivism — radical, cognitive, and social — actually provide different answers to the question of "where" this construction process takes place. Glasersfeld's radical constructivism confines knowledge entirely within the individual's world of experience, while Piaget's cognitive constructivism seeks a universal logic of cognitive development through the schema-assimilation-accommodation cycle; Vygotsky's social constructivism, in turn, argues that knowledge appears in the domain of social interaction before it appears in the individual mind. The point at which these three approaches diverge matters, because it carries different implications for classroom practice: radical and cognitive constructivism leave the student largely to their own process of discovery, while social constructivism opens more space for the active guiding role of the teacher and peers. It is worth noting here that the cooperating step of the REACT strategy overlaps particularly with these social constructivist foundations; the strategy assumes that knowledge is constructed not only through individual discovery but also through negotiation with peers.

Despite this theoretical richness, a frequently voiced criticism of constructivism's classroom application is that the approach speaks more clearly about "what should not be done" (for example, direct transmissive teaching) than about "what should be done." In other words, while constructivism insists that the teacher should move into the role of guide, it offers relatively few practical tools for what the concrete steps of that guidance

should look like. It is precisely at this point that the context-based learning approach enters: it is an attempt to translate the philosophical framework of constructivism into a concrete, classroom-applicable teaching logic.

2.2. Context-Based Learning: Reconnecting Knowledge with Life

The historical roots of context-based learning trace back to the Salters Project, developed at the University of York in England in the 1980s. The project's starting point is notable: this initiative, which began when a salt-trading company (Salters) wanted to bring the connection between the chemical industry and everyday life into the curriculum, quickly grew beyond a mere curriculum material into a teaching philosophy. This origin itself shows that context-based learning is not an academic laboratory invention but an approach born of the practical need between industry and education — which explains, at once, both its strength (applicability) and its limitation (the relatively weak theoretical systematicity).

At the core of the approach lies a simple but powerful premise: learning is not a process that starts from an abstract concept and is then "applied" to everyday life, but rather the reverse — a process that starts from a concrete event or problem in everyday life and arrives at the concept. This reversal of sequence is not cosmetic; it also changes the student's motivational position. In the traditional sequence, the student asks "why am I learning this?" at the end of the lesson, if at all; in the context-based sequence, this question is the starting point of the lesson and establishes the rationale for engagement from the outset.

The literature has developed more than one model that translates context-based learning into classroom practice; a comparative examination of these is instructive for clarifying where the REACT strategy stands within the field.

Keller's Four-Step Model (attention-relevance-confidence-satisfaction) is rooted in motivational psychology, and its strength is that it directly converts the student's affective process (interest, confidence, satisfaction) into steps. However, the model's relatively limited guidance on the cognitive process — that is, on how the concept is to be constructed — makes it more of an "introductory technique"; its scope is limited for carrying the backbone of an entire lesson or unit.

Panprueksa's FEACA Model (focusing-exploring-analyzing-conceptual development-application) handles the cognitive process far more systematically; in particular, keeping "analyzing" and "conceptual development" as separate steps leaves room for misconceptions to be noticed and corrected. However, the model does not explicitly include social interaction among students (cooperation) as a step, which makes its connection to social constructivist principles weaker compared with REACT.

The Wieringa, Janssen, and Van Driel Model (context adaptation-context-bound problem-application-reflection) adds a metacognitive layer through the "reflection" element at its final step, encouraging students to become aware of their own learning process. Although this partly overlaps with REACT's transferring step, REACT's transfer is more about "carrying" knowledge into a new context, whereas the reflection in the Wieringa model focuses on "thinking about" the process itself — a subtle but important difference.

Against this comparative background, the distinguishing feature of the REACT strategy is that its five steps (relating, experiencing, applying, cooperating, transferring) bring together the cognitive construction process, social interaction, and transfer capacity within a single cycle. This comprehensiveness — despite the limitations we will discuss later — has made the strategy the most frequently preferred context-based model in the literature.

2.3. The REACT Strategy: A Five-Step Learning Cycle

The REACT strategy was developed by the Center for Occupational Research and Development (CORD) and takes its name from the initial letters of the five words that compose it — Relating, Experiencing, Applying, Cooperating, and Transferring (Crawford, 2001). Each step of the strategy addresses a different cognitive or social function of the learning process; below, we not only define each step but also discuss its theoretical function and its applicability in the classroom.

Relating. This step answers the question of "why it matters" before the lesson even begins. The teacher activates the student's prior experience by starting from a story, a reading passage, a concrete object, or a daily event. Relating is the step most directly connected to constructivism among the five, because it prepares the ground on which new knowledge will be built by

activating the student's existing schemas. In classroom practice, the effectiveness of this step depends largely on how close the chosen context is to the real-life experience of the student group; an abstract or distant context reduces the relating step to a merely formal "warm-up activity" and causes it to lose its actual function.

Experiencing. In this step, the student encounters an activity (experiment, laboratory work, worksheet, simulation) that lets them directly experience the abstract concept. What must be emphasized here is that experiencing does not merely mean "doing something by hand"; the real aim is to ensure that the student encounters the concept through a channel suited to their own learning style (visual, auditory, tactile). Under-designing this step — for example, when the experiment is only demonstrated by the teacher while the student remains a passive observer — is the most common implementation error that weakens the strategy as a whole.

Applying. This is the use of the knowledge gained in the experiencing step in a task oriented toward a real-world problem. The function of this step is to move knowledge out of rote memorization and into a functional state; the student no longer merely "knows" but reaches the position of being able to "use." As Ingram (2003) emphasizes, the applying step has a function that elevates not just the internalization of knowledge but also the level of understanding.

Cooperating. This is students working together in small groups to negotiate knowledge. This step represents the strategy's social constructivist dimension; knowledge is shaped not only in the individual mind but also in dialogue among peers. It can be argued that the cooperating step is the most sensitive one in terms of classroom management — in cases where group dynamics are not well managed (for example, one student dominating the group), this step can turn from a learning opportunity into a waste of time.

Transferring. This is the strategy's final and perhaps most cognitively demanding step: the student carries the knowledge they have learned into a new situation different from its original context. This step is typically framed as homework, a research task, or problem-solving in a different context. Transfer is regarded as one of the strongest indicators of the durability of learning, because it shows that knowledge can be applied flexibly to different situations rather than remaining bound to a single context.

2.4. A Critical Interim Assessment: Where Do REACT's Limits Begin?

The comprehensiveness of the REACT strategy also harbors its greatest implementation risk: applying all five steps completely in every single lesson carries a high cost in terms of time and materials. Indeed, as we will see in the following section, this study also required a three-week (12 lesson-hour) implementation period — a serious feasibility constraint for schools with a tight curriculum schedule. Moreover, the systematic pursuit of the five steps requires the teacher to master not only subject-matter knowledge but also activity design, material preparation, and group-management skills; this increases the strategy's "teacher dependency" — that is, the extent to which the quality of implementation depends largely on the teacher's preparation effort. This observation will resurface when we interpret the inconsistent attitude findings discussed in later sections.

3. SYNTHESIS OF THE LITERATURE: WHAT DOES THE ACCUMULATED KNOWLEDGE ON REACT SAY?

An expanding body of empirical literature has accumulated on the REACT strategy since 2001 — since Crawford's study that systematized the strategy. Rather than presenting this literature as a chronological list, synthesizing it around four thematic axes makes both the field's accumulated knowledge and its knowledge gaps more clearly visible: (a) effects on academic achievement, (b) effects on attitude and motivation, (c) findings on the retention of learning, and (d) the strategy's distribution across disciplines.

3.1. Effects on Academic Achievement: A Relatively Consistent Pattern of Findings

The large majority of studies examining the effect of the REACT strategy on academic achievement report significant differences in favor of the strategy. In chemistry, Aktaş's (2013) computer-assisted REACT implementation on the particulate structure of matter and heat; in biology, Görmüş's (2021) study on the circulatory system; in social studies, Arıkan's (2019) research on the "People, Places, and Environments" unit; and, across science education generally, the materials Kirman Bilgin (2015) developed for the "Structure and Properties of Matter" unit all consistently report achievement gains in favor of the experimental group, across different age groups and different subject areas. A similar pattern is seen in the international

literature as well: Herlina, Turmudi, and Dahlan's (2012) study on mathematical communication skills conducted in Indonesia, and Quainoo, Otami, and Owusu's (2021) research on molecular genetics teaching in Ghana, produced similar results in different education systems.

At first glance, this consistency strengthens the impression that the REACT strategy has a reliable effect on academic achievement. A methodological caveat is necessary here, however: the majority of the studies examined were conducted in a quasi-experimental design with relatively small samples (generally in the range of 30-90 students). By their nature, quasi-experimental designs do not randomly assign groups but use existing classes; this keeps alive the risk that teacher effects, classroom climate, or unselected variables may confound the results. It is therefore more accurate to read the "consistent positive effect" finding in the literature as strong but not conclusive evidence for the effectiveness of the REACT strategy.

3.2. Effects on Attitude and Motivation: A Picture More Complex Than Expected

Unlike the academic achievement findings, the literature on the effect of the REACT strategy on student attitude and motivation presents a much more mixed picture — and this complexity may in fact be more instructive for the field than the achievement finding. On one hand, studies such as Ingram (2003), Çam (2008), and Özkan's (2022) study on matter cycles report that the REACT strategy significantly and positively affects students' attitudes toward the course. On the other hand, studies such as Görmüş (2021), Kılıç (2015), Ültay (2012), Yalçın (2020), and Yıldırım (2015) found that the same strategy did not create a statistically significant difference in attitude. Erdoğan Karaş's (2019) study on the seventh-grade cell and division unit goes even further, finding significant results in favor of REACT for academic achievement and retention while finding no trace of a significant increase on attitude and motivation scales.

This seemingly contradictory pattern of findings carries an important clue about the nature of the variable being measured, rather than reflecting a random inconsistency. Academic achievement is a cognitive outcome that can change relatively quickly through a direct teaching intervention; attitude, by contrast, is a relatively stable affective structure shaped by the accumulation of a much larger number of cumulative experiences (previous teachers, family

attitudes, peer interaction, general self-efficacy beliefs about the course). Expecting a three-week intervention to change an attitude that has settled over years to a statistically significant degree may be, from the outset, an ambitious assumption. Seen this way, the "inconsistent" findings on attitude may stem not from the strategy's failure but from attitude's natural resistance to change — which points to the need to evaluate the REACT strategy's effect on attitude not through a single application but through long-term, repeated implementations.

3.3. Retention of Learning: A Small but Robust Cluster of Findings

Retention — that is, the resistance of learned knowledge to being forgotten over time — has been studied less frequently in the REACT literature than academic achievement, but when studied, it has consistently resulted in favor of the strategy. Kirman Bilgin (2015) found that the REACT group retained its superiority over the control group in a delayed test applied ten weeks later; Ültay (2014) reported that the explanation-supported REACT strategy was more effective in retaining concepts related to impulse, momentum, and collisions in long-term memory. These findings coincide with a theoretical explanation suggesting that the strategy's five steps — particularly the experiencing and transferring steps — enable knowledge to leave a strong trace not only in short-term but also in long-term memory: knowledge acquired through multiple sensory channels and transferred into a real context is expected to leave a more resistant memory trace than knowledge acquired through a single channel (auditory narration alone).

3.4. Distribution Across Disciplines: The Dominance of Chemistry, the Gap in Physics

Perhaps the most striking structural feature of the literature is the uneven distribution across subject areas. A significant portion of the studies on the REACT strategy has focused on chemistry education (acid-base topics, gases, hydrocarbons, the particulate structure of matter), followed by studies in biology and mathematics. In physics topics — and especially in electricity teaching — by contrast, the testing of the REACT strategy has remained extremely limited. Although the reason for this imbalance is not entirely clear, it may be related to the fact that chemistry topics (for example, acid-base reactions, separation of mixtures) are more easily made concrete through everyday contexts compared with physics topics (for example, electrical

resistance, magnetic field). This explanation, however, is a hypothesis and is itself a candidate for a separate research question.

It is precisely this structural gap — the relatively limited testing of the REACT strategy in physics-based science topics — that is where the study underlying this chapter is situated. The topic of the transmission of electricity, as discussed above, offers a convenient area for filling this gap, given that it combines high abstraction with high frequency of everyday contact.

3.5. Implications of the Literature Synthesis

The picture emerging from this four-axis synthesis can be summarized as follows: the REACT strategy shows a relatively consistent positive effect on academic achievement and retention, while its effect on attitude and motivation varies from study to study; part of this variability may stem from the fact that attitude, by its nature, is more resistant to short-term interventions. The strategy follows a chemistry-dominant pattern in its distribution across disciplines and is relatively rarely tested in physics-based topics — including electricity teaching. The study underlying this chapter aims to examine the effect of the REACT strategy on the sixth-grade "Transmission of Electricity" unit together with the dimensions of academic achievement, attitude, and retention, focusing precisely on this last gap.

4. DESIGN OF THE STUDY: METHODOLOGICAL FRAMEWORK

4.1. Research Design and Rationale

A practical constraint frequently encountered in educational research is that it is not possible in school settings to randomly assign students to experimental and control groups altogether — classes are already formed, and student distribution is determined by administrative decisions. This reality directs education researchers toward a quasi-experimental design rather than a pure experimental design. This study, too, was built on a pretest-posttest control-group quasi-experimental design in light of this practical constraint: of two existing sixth-grade sections, one was designated as the experimental group and the other as the control group; the experimental group was taught with lesson plans aligned with the REACT strategy, while the control group was taught with the methods and techniques recommended by the existing curriculum.

The strength of the quasi-experimental design is its ability to produce findings with high ecological validity in real classroom settings; its limitation is the risk that the groups may not be fully equivalent at the outset. In this study, to minimize this risk, the equivalence of the pretests was statistically tested (as will be detailed in the findings section, no significant difference was found between the two groups at the outset), thereby strengthening the basis on which the posttest differences could largely be attributed to the teaching strategy applied.

4.2. Participants and Research Context

The participants of the study consist of a total of 32 sixth-grade students (experimental group n=17, control group n=15) attending a secondary school in the Akyazı district of Sakarya province during the 2021-2022 academic year. An important contextual feature that must be transparently stated here is that the entire sample consisted of male students — a characteristic arising from the structure of the school where the study was conducted, and one that should be considered an important limitation when interpreting the findings, particularly regarding the possible interactions of the gender variable with attitude and achievement. We return to this issue in the discussion and limitations section.

4.3. Data Collection Instruments

Two main quantitative data collection instruments were used in the study. The first is a 28-item achievement test (FBASYÜAT) developed by the researcher, covering the five learning outcomes of the sixth-grade "Transmission of Electricity" unit. The development process of the test demonstrates a rigor that can be considered good practice in field education research: the item pool was submitted for the opinions of six experts consisting of three science teachers, two academics, and one Turkish language teacher, after which a pilot application was conducted with 332 seventh-grade students from eight different schools, and item difficulty (.477) and item discrimination (.386) indices were calculated to eliminate weak items. The internal consistency of the test (Cronbach's Alpha = .762) is at an acceptable level.

The second instrument is a 36-item, five-point Likert-type scale originally developed by Özcan and Koca (2020) under the name "Attitude Towards Science Scale," adapted by the researcher, with the necessary

permissions obtained, under the name "Science Course Attitude Scale" (FBDTÖ) (Cronbach's Alpha = .93). While the high reliability coefficient shows that the scale measures the attitude dimension in a stable manner, it should be noted that the original form of the scale targets a general attitude "toward science," and the version adapted by the researcher to be course-specific did not undergo a separate validity study; this is a subtle but important point to bear in mind when interpreting the measurement instrument.

4.4. The REACT Strategy Made Concrete in the Classroom: Three Case Examples

Showing how a theoretical strategy translates into classroom practice is more instructive than simply listing the steps. For this reason, we detail here three concrete examples from the three-week implementation process.

First example — constructing the concept of conductor and insulator. The lesson began with a reading passage titled "Battery Boost Service" and real battery cables brought into the classroom (relating). After encountering this concrete object, students tested the concept of conductivity themselves through an individual experimental activity titled "Which Substances Conduct Electrical Energy?" (experiencing). They then systematized their findings on a worksheet (applying), completed the "Conductor or Insulator?" activity together in groups of four (cooperating), and finally transferred what they had learned to a new context through a homework assignment investigating which materials the electrical energy travelling from the power plant to the home passes through (transferring).

Second example — the reflection of conductivity and insulation in everyday tools. The lesson began with a voltage tester and a pair of pliers, triggering students' curiosity about the structure of these tools (relating). Through the activity "Conducting an Experiment on the Uses of the Conductivity and Insulation Properties of Materials," students directly observed how these properties are used in the design of everyday tools (experiencing), applied their findings on a worksheet (applying), completed the "Conductors Together with Insulators" activity with their group (cooperating), and transferred their knowledge through a task investigating the conductive and insulating materials in the interior components of an automobile (transferring).

Third example — electrical resistance and the factors it depends on. In this eight-lesson-hour block, which began with a reading passage titled "Water Slides" (relating), students tested the effect of conductor length, cross-section, and type on bulb brightness through individual experiments (experiencing), systematized their findings on the "Electrical Resistance and the Factors It Depends On Worksheet" (applying), conducted comparative experiments in groups with aluminum and nickel-chromium wire samples (cooperating), and transferred their knowledge to new contexts by researching and presenting to the class the resistances in three different devices they use in daily life (transferring).

These three examples show that the REACT strategy, far from being an abstract "list of five steps," turns into an intensive teacher preparation process requiring concrete material design, time management, and group dynamics. Indeed, a total of three worksheets, ten experiment reports, and two activity sheets had to be developed in advance and reviewed by experts for the three-week implementation — concrete evidence of the "teacher dependency" critique we noted in Section 2.4.

5. FINDINGS: WHAT DOES THE DATA SAY?

In this section, the findings obtained from the study are presented not as a raw sequence of statistical outputs but as a narrative synthesized within the logical flow of the research questions asked. Where the reader needs statistical detail, this data is presented collectively in Table 1.

5.1. The Starting Point: Were the Groups Really Equivalent?

For any intervention effect to be interpretable, it must first be shown that the two groups were close to each other at the outset. The findings are reassuring in this respect: no statistically significant difference was found between the two groups either on the academic achievement pretest (control group mean 29.47; experimental group mean 35.12; t=-1.384, p=.177) or on the attitude pretest (control group mean 145.00; experimental group mean 152.65; U=92.00, p=.178). This result is a critical precondition that strengthens the internal validity of the study: the experimental and control groups were close to each other both in their prior readiness on the topic and in their initial attitudes toward the science course; therefore, the differences

that would emerge on the posttest could largely be attributed to the teaching approach applied.

5.2. Academic Achievement: A Clear and Lasting Difference in Favor of the REACT Group

After the three-week implementation, the picture in the posttest changed markedly. The control group's mean rose to 60.07 and the experimental group's mean to 76.24; the difference between them was found to be statistically significant (t=-3.266, p=.003). Both groups showed progress compared with the pretest, but the progress in the experimental group (approximately 41 points) was markedly higher than that in the control group (approximately 31 points).

To understand whether this difference is a temporary "novelty effect" or a lasting learning gain, the retention test applied three weeks later plays a decisive role. In the retention test, the control group's mean fell back to 46.20 (a loss of approximately 14 points), while the experimental group's mean remained at 70.00 (a loss of approximately 6 points); the difference persisted, growing stronger in favor of the experimental group (t=-4.200, p<.001). This pattern is notable in that it shows that the knowledge acquired through the REACT strategy was not only higher but also more resistant over time; the control group's forgetting curve steepened markedly, while the experimental group's curve remained relatively flat.

5.3. Attitude: Same Direction, More Modest Magnitude

A pattern in favor of the experimental group is also observed in the attitude findings toward the science course, though the magnitude of the difference is more modest compared with the academic achievement findings. On the posttest, the control group's mean was calculated as 148.53 and the experimental group's mean as 160.35, and the difference between them was found to be statistically significant (the Mann-Whitney U test was used due to unequal variances, U=51.00, p=.004). A similar difference persisted in the same direction on the retention test as well (control=146.46, experimental=164.82; U=59.50, p=.010).

It is important to consider what this pattern of findings means within the 36-180 point range of the 36-item scale: the means of both groups fall in the upper half of the scale (the scale midpoint is 108), suggesting that the students at the school where the study was conducted already came in with a

relatively positive attitude toward the science course. At a starting point this close to a "ceiling effect," the capacity of any intervention to raise attitude further will naturally be limited. This observation also supports, in the context of this study, the interpretation we discussed in the literature synthesis that "attitude is relatively resistant to change."

5.4. Delayed Retention: Is the Difference Still Standing After Sixteen Weeks?

The most ambitious component of the research design is the delayed retention test applied sixteen weeks after the posttest; this measurement aims to test whether the gains acquired through the REACT strategy are lasting not only in the short three-week term but also at the scale of a full semester. The findings are notable in this respect: in academic achievement, the control group's mean fell back to 45.91 and the experimental group's mean to 66.07; the difference remained statistically significant in favor of the experimental group, as it did in the three-week retention test ($t=-3.000$, $p=.006$). While the control group's total loss over the sixteen weeks relative to the posttest score was approximately 14 points (from 60.07 to 45.91), the experimental group's loss remained at approximately 10 points (from 76.24 to 66.07) — indicating that the pattern observed in the three-week retention test, in which "the experimental group's forgetting curve runs flatter," largely persists after sixteen weeks as well.

The direction is the same in the attitude findings too, but this time the statistical strength of the difference remained marginal: the control group's mean was calculated as 142.07 and the experimental group's mean as 159.31, and the difference between them was found significant using the Mann-Whitney U test ($U=64.50$, $p=.048$). The proximity of this p-value to the .05 threshold is consistent with the "attitude is relatively resistant to change" interpretation discussed in Section 5.3: while the academic achievement difference persists strongly over time, the attitude difference retains its statistical significance at the end of sixteen weeks but loses statistical power.

Reading these two findings together, the picture that emerges is this: the academic gain acquired through the REACT strategy remains markedly standing even in the nearly four months that pass after a three-week implementation; the positive difference in attitude, while retaining its direction over the same period, follows a more fragile course. This pattern

offers relatively rare evidence, through a physics-based topic, for the long-term retention question tested by only a small number of studies in the literature (e.g., Kirman Bilgin, 2015; Ültay, 2014).

Table 1. Summary Overview of the Research Findings

Measure	Control Group (M)	Experimental Group (M)	Statistic	p
FBASYÜAT Pretest	29.47	35.12	t = -1.384	.177
FBASYÜAT Posttest	60.07	76.24	t = -3.266	**.003**
FBASYÜAT Retention Test (3 weeks)	46.20	70.00	t = -4.200	**<.001**
FBASYÜAT Delayed Retention Test (16 weeks)	45.91	66.07	t = -3.000	**.006**
FBDTÖ Pretest	145.00	152.65	U = 92.00	.178
FBDTÖ Posttest	148.53	160.35	U = 51.00	**.004**
FBDTÖ Retention Test (3 weeks)	146.46	164.82	U = 59.50	**.010**
FBDTÖ Delayed Retention Test (16 weeks)	142.07	159.31	U = 64.50	**.048**

6. DISCUSSION: HOW DO THE FINDINGS SPEAK WITH THE LITERATURE?

6.1. The Academic Achievement Finding: In the Expected Direction, Stronger Than Expected

The academic achievement findings obtained from this study largely overlap with the literature we synthesized in Section 3.1: the REACT strategy produced a significant increase in achievement in electricity teaching as well — just as it did in chemistry and biology topics. This overlap is important, because the majority of the findings in the literature came from chemistry-

based topics; this study strengthens the evidence for the strategy's cross-disciplinary generalizability by showing that the effect is observed — at least as strongly as in chemistry topics — in a physics-based topic with a high level of abstraction.

Summarizing the mechanism underlying this effect merely as "REACT works" remains superficial; the process needs to be unpacked a little further. While control-group students most likely learned the concept of electrical resistance at the level of formulas and definitions, experimental-group students constructed the same concept through comparative experiments they conducted with aluminum and nickel-chromium wires, based on the difference in bulb brightness they observed themselves. Acquiring knowledge in this way, anchored through multiple sensory channels (visual observation, tactile experimentation, written record, verbal discussion) and to a real context (automobile parts, water slides, battery cables), both strengthened the initial learning and — as the retention findings show — conferred resistance against forgetting.

6.2. The Attitude Finding: A Data Point That Explains the Contradiction in the Literature

The attitude findings of this study offer a result that stands between, rather than directly supporting either of, the "positive effect" and "no significant effect" poles in the literature: a difference that is statistically significant but modest in magnitude. This position directly supports the interpretation we proposed in Section 3.2 — that attitude is a structure more resistant to short-term interventions compared with achievement. Students' starting attitudes, already in the upper half of the scale, left limited room for a three-week intervention to raise attitude much further. This observation reminds future research to attend not only to statistical significance but also to effect size and to ceiling/floor effects at baseline when evaluating attitude effects.

6.3. Limitations: Within What Boundaries Should the Findings Be Read?

The findings of this study should be interpreted cautiously in light of four important limitations.

First, **sample size and single-school/single-region structure**: a sample of 32 students, even where it reaches statistical significance, limits the generalizability of the findings to different socioeconomic and geographic

contexts. Second, and perhaps more critical, **the sample consisting entirely of male students**: this leaves entirely open the question of whether the effect of the REACT strategy differs by gender. A replication study conducted in mixed-gender classes could both test the strategy's generalizability and fill the gap in the literature regarding the interaction of gender with context-based teaching. Third, **a single researcher taking on both the teacher and researcher roles**: while this offers an advantage in increasing the consistency of implementation, it does not allow us to entirely rule out the possibility that researcher expectancy (such as unconscious enthusiasm transmitted toward the experimental group) affected the results. Fourth, given that the attitude difference in the sixteen-week delayed retention test remained statistically marginal at p=.048, **interpretations of the long-term course of attitude should be made cautiously**: although this p-value crosses the significance threshold, it is not yet known whether the same effect would re-emerge in a larger sample.

7. IMPLICATIONS FOR PRACTICE: BACK TO THE CLASSROOM

Translating this chapter's theoretical and empirical discussion into concrete implications for science teachers and instructional material developers is one of the most practical contributions a book chapter can offer its reader.

Locality should take priority in context selection. The contexts used in this study, such as "battery boost service," "water slides," and "automobile parts," were chosen close to the everyday experience of a student group in a rural/small-town setting. It is critical for the strategy's effectiveness that a teacher applying the same strategy in a large city or a different socioeconomic setting redesign the contexts — rather than directly copying them — to fit their own student group's world of experience.

The experiencing step is the step with the heaviest material planning. The ten experiment reports in this study required significant advance preparation in terms of material procurement and laboratory safety. In schools with limited materials and time, supporting the experiencing step with virtual laboratory simulations — without compromising the strategy's core logic — can increase feasibility.

The cooperating step is sensitive to group size. In activities conducted in groups of four, clarifying role distribution within the group in advance (for example, who records, who runs the experiment, who presents) is decisive in preventing this step from turning from a learning opportunity into a waste of time.

Transfer tasks should be designed as part of the assessment. In this study, the transferring step was mainly framed as homework; however, given the strong effect of transfer on the durability of learning, positioning these tasks not merely as an additional item expected to be completed but as a graded assessment component may increase student motivation.

8. LOOKING AHEAD: RESEARCH AGENDA AND CONCLUSION

The study addressed in this chapter, and the broader literature within which it is situated, show that the REACT strategy carries strong potential for academic achievement and retention in science teaching — particularly in physics-based topics with a high level of abstraction — while its effect on attitude requires more cautious interpretation. The following agenda items stand out for future research.

First, **replicating this study's sixteen-week delayed retention finding in larger and mixed-gender samples** is a priority need for the field. Given that the study's attitude delayed-retention difference remained marginally significant at p=.048, replication studies revealing the extent to which this finding varies with sample size and gender composition are critical for both statistical reliability and generalizability. Second, **replication studies in mixed-gender samples** could address this study's most notable limitation and fill the large gap in the literature regarding the interaction of gender with context-based teaching. Third, testing the REACT strategy **in other abstract topics of physics** (magnetism, pressure, motion) could answer the question of whether this study's effect is specific to electricity or general to physics. Fourth, given the modest effect size in the attitude finding, **longitudinal implementations spanning a full academic year rather than a single term** testing the cumulative effect on attitude could offer a distinctive contribution to the field. Finally, the effect of the REACT strategy on variables not directly measured in this study — such as **conceptual understanding, remediation**

of misconceptions, inquiry skill, and scientific process skills — is important for mapping the full scope of the strategy's impact.

In conclusion, starting from the premise that learning weakens where context is lost, this chapter has shown that the REACT strategy — as a bridge in which each of the five steps serves a distinct theoretical function, yet which as a whole translates constructivism's philosophical promise into classroom practice — can turn this premise into a concrete teaching application. The findings obtained on a topic as abstract yet as intertwined with everyday life as the transmission of electricity demonstrate that the strategy is not a tool specific to chemistry classrooms alone, but a teaching approach that deserves careful consideration across science education in general — with due regard, of course, for the limitations and future research needs outlined above.

REFERENCES

Aktaş, L. (2013). *Maddenin tanecikli yapısı ve ısı konusunda REACT öğretim stratejisine yönelik geliştirilen bilgisayar destekli öğretim materyalinin öğrenci başarısına etkisi* [The effect of computer-assisted instructional material developed for the REACT teaching strategy on the topics of the particulate structure of matter and heat on student achievement] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Arıkan, A. (2019). *Sosyal bilgiler dersinde REACT stratejisine dayalı etkinliklerin öğrencilerin akademik başarılarına, sosyal bilgiler dersine yönelik tutumlarına ve öğrenmenin kalıcılığına etkisi* [The effect of REACT-strategy-based activities in the social studies course on students' academic achievement, attitudes toward the social studies course, and retention of learning] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Arslan, M. (2007). Eğitimde yapılandırmacı yaklaşımlar [Constructivist approaches in education]. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi, 40*(1), 41-61. https://doi.org/10.1501/Egifak_0000000150

Aydın, H. (2012). *Felsefi temelleri ışığında yapılandırmacılık* [Constructivism in light of its philosophical foundations]. Nobel Yayınları.

Bay, E. (2008). *Öğretmen eğitiminde yapılandırmacı program uygulamalarının etkililiğinin değerlendirilmesi* [Evaluating the effectiveness of constructivist program applications in teacher education] (Unpublished doctoral dissertation). Atatürk University.

Bennett, J., & Lubben, F. (2006). Context-based chemistry: The salters approach. *International Journal of Science Education, 28*(9), 999-1015. https://doi.org/10.1080/09500690600702496

Can, A. (2022). *SPSS ile bilimsel araştırma sürecinde nicel veri analizi* [Quantitative data analysis in the scientific research process with SPSS] (10th ed.). Pegem Akademi.

Clifford, M., & Wilson, M. (2000). *Contextual teaching, professional learning, and student experiences: Lessons learned from implementation* (Educational Brief No. 2). Center on Education and Work, University of Wisconsin-Madison.

Crawford, M. L. (2001). *Teaching contextually: Research, rationale, and techniques for improving student motivation and achievement in mathematics and science*. CCI Publishing.

Çam, F. (2008). *Biyoloji derslerinde yaşam temelli öğrenme yaklaşımının etkileri* [The effects of the life-based learning approach in biology courses] (Unpublished master's thesis). Atatürk University.

Demirel, Ö. (2012). *Eğitim sözlüğü* [Dictionary of education] (5th ed.). Pegem Akademi.

Erdoğan Karaş, Ö. (2019). *7. sınıf hücre ve bölünmeler ünitesinin REACT stratejisiyle öğretimi* [Teaching the seventh-grade cell and division unit with the REACT strategy] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Görmüş, G. (2021). *Dolaşım sistemi konusunun öğretiminde bağlam temelli öğrenme yaklaşımındaki REACT stratejisine göre hazırlanan etkinliklerin öğrencilerin öğrenme ürünleri üzerine etkisi* [The effect of activities prepared according to the REACT strategy within the context-based learning approach on students' learning products in teaching the circulatory system] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Güneş, L. (2022). *Altıncı sınıf elektriğin iletimi ünitesinin REACT stratejisi ile öğrencilerin akademik başarısına etkisinin incelenmesi* [Investigating the effect of the sixth-grade transmission of electricity unit taught with the REACT strategy on students' academic achievement] (Master's thesis). Sakarya University, Institute of Educational Sciences.

Herlina, Turmudi, & Dahlan, J. A. (2012). The effect of REACT strategy in improving mathematical communication of senior high school students. *Proceedings of International Seminar on Mathematics, Science, and Computer Science Education*.

Ingram, S. J. (2003). *The effects of contextual learning instruction on science achievement of male and female ninth grade students* (Doctoral dissertation). Texas A&M University.

Kanuka, H., & Anderson, T. (1998). *They began with the insights of Socrates who claimed that there are basic conditions for learning that are in the cognition of the individual*. http://www.nwlink.com/~donclark/hrd/history/constructivism.html

Kılıç, M. A. (2015). *Bağlamsal öğrenme ve öğretme yaklaşımının ilköğretim 7. sınıf öğrencilerinin matematik başarılarına, matematiğe yönelik tutumlarına ve matematiği günlük hayat problemlerine transfer etmelerine etkisi* [The effect of the contextual teaching and learning approach on seventh-grade students' mathematics achievement, attitudes toward mathematics, and transfer of mathematics to everyday life problems] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Kirman Bilgin, A. (2015). *Maddenin yapısı ve özellikleri ünitesi kapsamında REACT stratejisine yönelik tasarlanan öğretim materyallerinin etkililiğinin değerlendirilmesi* [Evaluating the effectiveness of instructional materials designed for the REACT strategy within the structure and properties of matter unit] (Doctoral dissertation). Council of Higher Education Thesis Center, Turkey.

Kömez Ataman, S. (2017). *KPSS 2017 eğitim bilimleri öğretim yöntem ve teknikleri* [KPSS 2017 educational sciences: teaching methods and techniques]. Yedi İklim.

Özcan, H., & Koca, E. (2020). Development of the attitude towards science scale: A validity and reliability study. *Eurasian Journal of Educational Research, 85*(6), 109-134. https://doi.org/10.14689/ejer.2020.85.6

Özkan, Z. (2022). *Madde döngüleri ve çevre sorunları konusunun REACT stratejisi ile öğretiminin sekizinci sınıf öğrencilerinin araştırma-sorgulamaya dönük tutumlarına, fen konularına yönelik ilgilerine ve akademik başarılarına etkisi* [The effect of teaching the topic of matter cycles and environmental problems with the REACT strategy on eighth-grade students' attitudes toward inquiry, interest in science topics, and academic achievement] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Quainoo, B. A., Otami, C. D., & Owusu, K. A. (2021). Effect of the REACT strategy on senior high school students' achievement in molecular genetics. *LUMAT: International Journal on Math, Science and Technology Education, 9*(1), 696-716. https://doi.org/10.31129/LUMAT.9.1.1418

Ültay, E. (2014). *İtme, momentum ve çarpışmalar konusuyla ilgili bağlam temelli öğrenme yaklaşımına dayalı açıklama destekli REACT stratejisine göre geliştirilen etkinliklerin etkisinin araştırılması* [Investigating the effect of explanation-supported REACT-strategy-based activities related to impulse,

momentum, and collisions, grounded in the context-based learning approach] (Doctoral dissertation). Council of Higher Education Thesis Center, Turkey.

Ültay, N. (2012). *Asit ve baz konusuyla ilgili REACT stratejisine ve 5E modeline göre etkinliklerin geliştirilmesi, uygulanması ve karşılaştırılması* [Developing, implementing, and comparing activities based on the REACT strategy and the 5E model for the topic of acids and bases] (Doctoral dissertation). Council of Higher Education Thesis Center, Turkey.

Wieringa, N., Janssen, F. J. J. M., & Van Driel, J. H. (2011). Biology teachers designing context-based lessons for their classroom practice: The importance of rules-of-thumb. *International Journal of Science Education, 33*(17), 2437-2462. https://eric.ed.gov/?id=EJ950572

Yalçın, O. (2020). *Disiplinler arası bağlam temelli öğrenme yaklaşımına dayalı fizik öğretim programının uygulanma süreci ile öğrencilerde bilişsel ve duyuşsal açıdan yarattığı değişimin incelenmesi* [Investigating the implementation process of an interdisciplinary context-based physics curriculum and the cognitive and affective change it creates in students] (Doctoral dissertation). Council of Higher Education Thesis Center, Turkey.

Yıldırım, G. (2015). *İlkokul 4. sınıf fen ve teknoloji dersinde bağlam temelli öğrenme uygulamaları* [Context-based learning applications in the fourth-grade science and technology course] (Master's thesis). Council of Higher Education Thesis Center, Turkey.

Student Academic Performance Evaluation Using Data Visualization Techniques

Olta LLAHA*

Azir ALIU [2]

[1]Faculty of Contemporary Sciences and Technologies, SEE University, Tetovo, North Macedonia
[2] Faculty of Contemporary Sciences and Technologies, SEE University, Tetovo, North Macedonia
*(ol29064@seeu.edu.mk)

ABSTRACT

Assessment is a process that produces information for educators that they may use to make decisions regarding students' learning. Nowadays one of the great difficulties that educational institutions face, is the increasing growth of educational data and the use of it to improve the quality of making decisions in regard to education. Data visualization methods help to create useful and valid analyses from higher education databases. They also ensure students maximize their academic output. Here we present the evaluation of students for different subjects, graduation levels, student enrollment and by the use of data visualization techniques we make an analysis of the study results. We show the importance of data visualization in data analysis which has a significant impact on the accuracy of the predicted results.

Keywords – Data Visualization, Higher Education, Knowledge Discovery

I. INTRODUCTION

Nowadays by increasing the importance of information in all sectors, illustrating data in an interactive way helps those who make decisions understand and analyze effectively and big amounts of information in no much time. Students are the main assets of higher education Institutions. Student outcomes play an important role in producing the best quality graduates and post-graduates. They will become the leaders and workers of their countries, and thus they will be the source of their country's economic growth and social development. Academic results are one of the main factors that employers use to recruit workers, especially in the case of recent graduates. Thus, students must place great effort in their studies to obtain good academic results to fulfill employer demands. Information coming out of visualization, as a way of presenting different data types in a form that is easier to take in, is growing increasingly in various areas [1] and one of them is higher education. Some visualization techniques involve plots or graphs, tables, diagrams, or multidimensional renderings. Data is always increasing in quantity and becoming integrated into our daily lives that makes visualizations more and more necessary. For higher education institutions whose purpose is to contribute to quality improvement, the success of human capital creation is the subject of ongoing analysis [1]. The purpose of this study is to use data visualization for student assessment, enrollment and graduation. Also to see how this visualization affects the decision making by professors, administrators or leaders of the educational institution. In order to do this we do the visualization of student data regarding their assessments in various subjects, their graduation in years and their registration in years. From year to year there are changes and thanks to the visualization pedagogues, management, etc. take action to improve the situation.

Pedagogues in order to increase the students' performance intervene in the curriculum and also administrators improve marketing campaigns, based on legislation or guidelines of the relevant ministry. This paper has the following sections: Section 2 describes the relationship that exists between data visualization and higher education. Section 3 contains the description of the dataset and the methodology. Section 4 contains the results of the application of methods of data visualization. In section 5 the conclusions are discussed.

II. Data Visualization And How It Is Used In Higher Education

The primary purpose for data visualization is to assist people with processing large amounts of information. Data volumes are large and human cognitive capacities to remember and understand data are limited [2]. Data visualization should be made to simplify visualization as much as possible to help people make more effective decisions. Put simply, data visualization is a method of producing an output so that all problems and solutions can be clearly seen by domain expert [3]. In general, visualization techniques are great tools that can assist people to understand information. Visualizations can help make difficult relationships more easily understood and can stimulate visual thinking [4]. Clearly defining academic success is important for predicting academic success in higher education. Klein C et al. [5] have carried out a case study. This included research done at a public university in the mid-Atlantic region of the United States to examine undergraduate use of learning analytics dashboard (LAD) interventions. The results show that student understanding is connected with data relevance, accuracy and context. One conclusion of our study is that the material after the interventions that have been made in the curriculum has affected the result of students understanding, a result that is realized through visualization. The study of Akanmu, Semiu et al. included findings regarding the meaning of HEI current data management practices as well as the elicitation of domain policy-makers' explicit knowledge preferences [6]. The data dimensions also assist with making the choice of visualization, interaction and analytic techniques. Starting from the latter in relation to the dimensions of the data we were focused on data related to student assessments, graduation and their enrollment in different academic years, which are numerical data. Information visualization techniques that give the benefits of visual perception are considered as tools for presenting data through the conversion of tracks into visual information [7]. One of the visualization techniques used in our study as in [7] is a chart which graphically presents information about students. Information related to their evaluation in various subjects. By using data visualization we can make a better analysis of student assessments. We can also make decisions to improve their performance, to inform students more effectively of their performance on a subject or

different subjects of an academic year using visualizations of up to date assessments, comparisons with the average results of the class as a whole, and projections of potential future outcomes. In turn, this might make students change their behavior for the better, based on their observations of the graphs.

III. Data And Methodology

This study presents the visualization of the evaluation data of the students of the Informatics Applied study program at Logos University College. Microsoft Power BI was used to visualize the data. Microsoft Power BI is a Data Visualization platform that has a focus on the creation of a data-driven business intelligence culture in all modern organizations. In order to carry out this role, it provides self-service analytics' tools, which can be employed to analyze, aggregate and share the data in a useful manner [8].

The data are extracted from the Edu Page system. It is traditionally presented in a tabular format showing the student's score on each subject. There are some benefits of visualizing numerical data in a graphical format and one of them is a more efficient and clearer interpretation of the data [9]. Based on the extracted data, data sets in excel format are created and through visualization a detailed analysis is made. This analysis aims to make decisions regarding the quality of teaching or interaction in the curriculum. The data that will be visualized are data that represent the evaluations of students of Applied Informatics. The evaluations are for each subject of this study program.

In this paper are used some data visualization techniques such as charts, graphs and maps.

A. Charts

What is the easiest method to display how one or more data sets develop? It is a chart, of course. Charts have a variety of forms, such as bar and line charts, which may show relationships between items over time. Pie charts can show how the elements or portions relate together within a whole.

A line chart is created by connecting data points within a data series using line segments. Line charts are frequently employed for showing trends in data that vary continuously over a period of time or range [10].

B. Maps

Maps are another popular technique. They are used for data visualization in a variety of business fields. They help locate elements of relevant objects and areas on geographical maps, building plans, website layouts, etc. Some of the most popular forms of maps are heat maps, dot distribution maps and cartograms [11]. Maps are types of visualization used to show what differences are in data through variations in color, size, position, space etc.

These charts use color to show values in a way that makes it easier for the viewer to quickly identify trends. Maps are often used for representing topographical and geographical information but they have been used in such way that can exhibit very useful data [12].

C. Graphs

The use of graphs provides a general means to transform the data and their relationships into an abstract view for showing complex relationships and improving data comprehension. Meanwhile, graphs can also be adjusted flexibly to answer specific questions based on the distinctive characteristics of the data [13]. We demonstrate the effectiveness of graph-based representations by applying them to our data.

Data visualization can improve the use of data in higher education. A variety of different types of stakeholders in the higher education community routinely use data to make decisions. Pedagogues look at student performance data to identify knowledge, gaps, and then adjust syllabi according to instructions. Administrators look at registrations to determine courses and create schedules. Some of the scenarios used in this paper are exam results, graduation levels and student enrolment.

IV. DATA VISUALIZATION-EXPERIMENTAL RESULTS

Logos University College is a non-profit private academic institution. Logos University College is accredited as an institution and through its organizational structure offers accredited study programs in the first and second cycle. Its study programs are in line with the needs of society and inspire knowledge, innovation, research, practice, employment in the labor market, promotion of human values and culture. Currently Logos University College consists of three faculties: Faculty of Applied Sciences, which has three departments: Department of Medical Sciences; Department of Applied Informatics and Statistics; Department of Health Sciences and Social Welfare; Faculty of Economics with three departments: Department of Finance and Accounting; Department of Management; Department of Agribusiness; and the Faculty of Humanities and Linguistic Communication with three departments: Department of Languages and Literature; Department of Theology and Culture; Department of Pedagogy and Psychology.

The institution has about 100 employees, of which 75 are academic staff, including management staff such as rector, deans, heads of departments, etc, and 25 are part of the administration such as learning/teaching secretary, finance sector, human resources sector, etc. Logos University College is dedicated to equip students with individual and professional perspective, extracurricular activities, internships, international nobilities, and career mentoring, as it was based on the Foundation’s vision and the Decision of the Senate and the Board of Administration.

In this paper, as we have pointed out in section 3, we are focused on the Department of Applied Informatics and Statistics and on the programming of this department, that of Applied Informatics. To conduct this study we used Power BI software based on the approach and familiarity with its use.

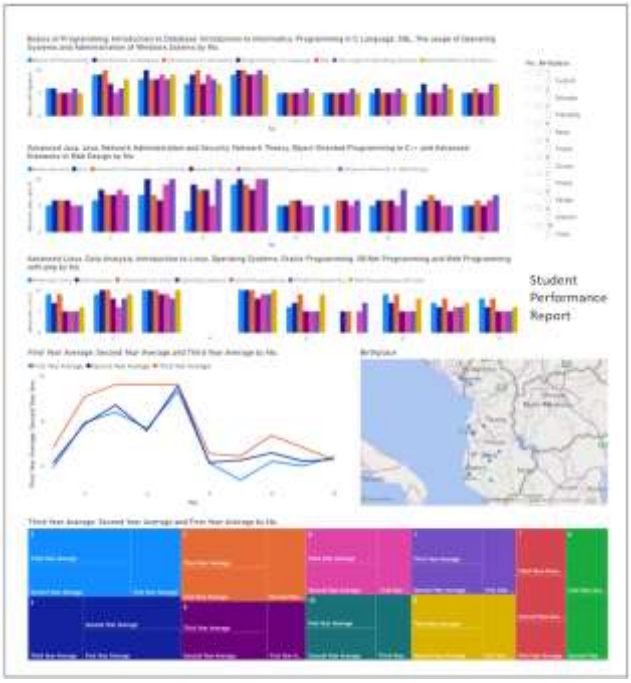

Fig.1 Student Performance Report 2017-2020

Figure 1 presents the evaluation report for students who have attended studies in the period 2017-2020. The report presents the evaluation for the special subjects that the students have attended in the first, second and third year of studies. The average of each of them in the three academic years is also presented. As can be seen in the figure, the evaluations for the student with code 4 in the third year of studies are missing, because this student did not participate in any exam of that academic year. The map also shows the birthplace of each student.

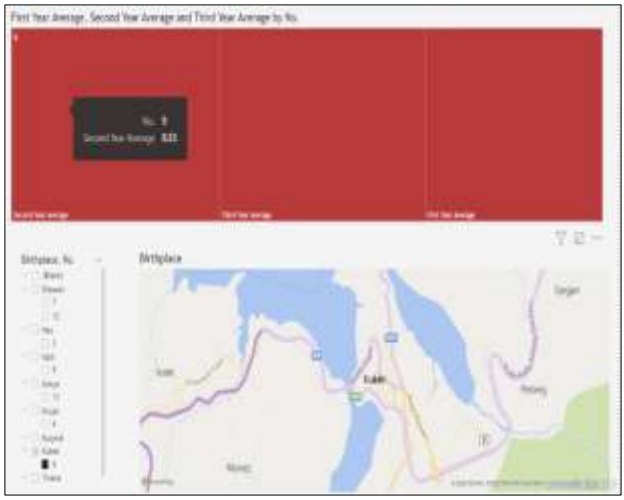

Fig. 2 Evaluation report for the student with code 9 (2018-2021)

Figure 2 presents the evaluation report for the student with code 9, who is from Kukës and has an average of the second year of studies 8.93. His birthplace is visualized through the mapping technique.

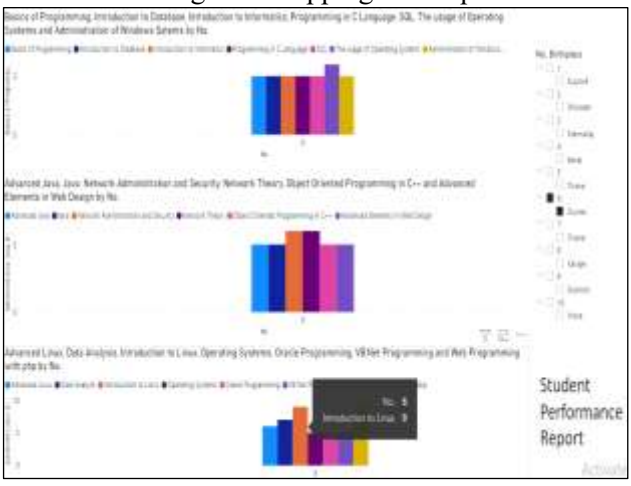

Fig.3 Evaluation report for the student with code 5 (2017-2020)

Figure 3 presents the report for the student with code 6, who is from Durres and in the course Introduction to Linux, the course developed in the third year of studies is evaluated with a grade of 9.

Based on the visualization of student evaluations for the periods 2017-2020 and 2018-2021 we make an analysis of these visualizations and data regarding students' evaluation. In the period 2018-2021 the results of students for special subjects and in general are higher because the lecturers of the subjects have made improvements to the syllabi in the following year

and these improvements reflect the higher results of students in these years, compared to previous years.

Dashboards displaying the history of students' results and assessments are handy for picking out those who seem to be doing well or at risk in particular or general course content areas, since the subjects consist of modules, developed in two semesters of the academic year. Scholar development throughout the whole academic period can give pedagogues with experimental data for activity-oriented decision making and educational intervention at the individual level on time.

Fig. 4 Report of enrolled students

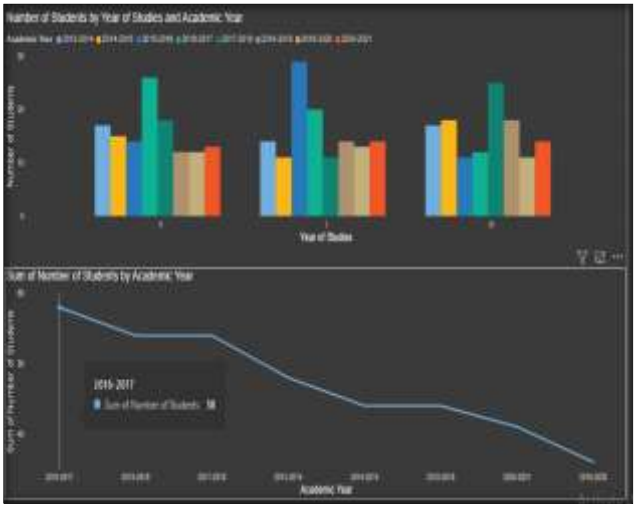

Fig. 5 Report of students enrolled in the academic year 2016-2017

Figure 4 and Figure 5 present the report of student enrollments in the Informatics study program applied in different academic years starting from the academic year 2013-2014 until 2020-2021. Figure 4 presents a detailed enrollment report while figure 5 specifies the number of enrollments for the 2016-2017 academic year which is 58 students divided by years, first year 20 students, 26 students in the second year and 12 students in the third year. It is noticed that over the years the number of enrolled students is declining. There are several reasons for this and an analysis is done for this. One of the reasons is the establishment of the average in high school where graduates who finish with an average greater than 6.5 have the right to continue higher education. This is set for the academic year 2017-2018 and onwards. Another reason is the smaller total number of graduates who compete for higher studies and a part of whom continue their higher studies abroad. This is an analysis of the change in student enrollment in different academic years.

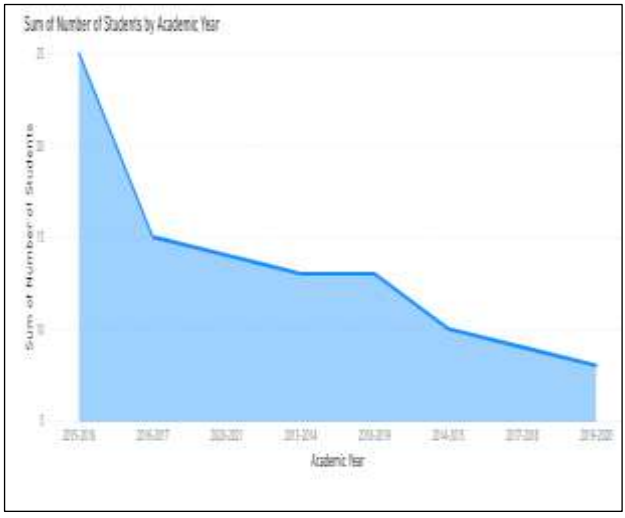

Fig. 6 Graduate student report

Figure 6 presents the ratio of graduate students in the Informatics study program implemented in different academic years, starting from the academic year 2013-2014 to 2020-2021. It is noticed that the number of graduates depends on their evaluation during the three academic years, as there are students who as a result of poor results have not managed to close the 3-year cycle and graduate at the end of this cycle. This is more clearly evidenced in Figure 7.

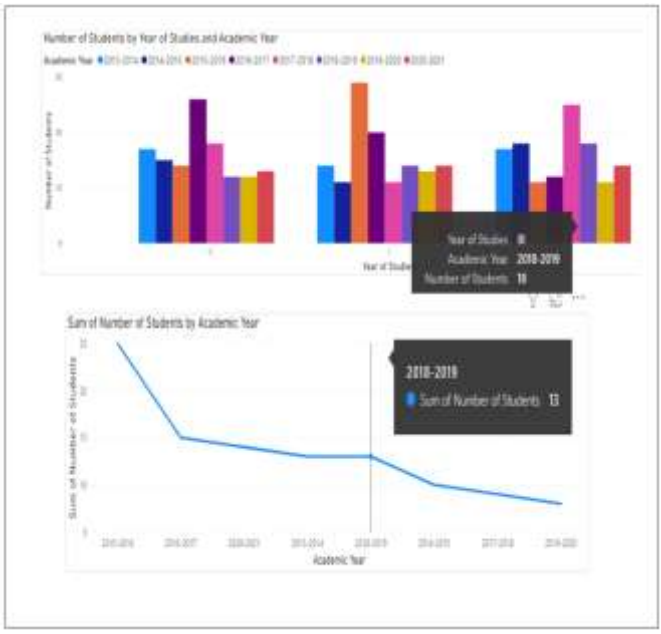

Fig. 7 Enrolled and graduate students in the 2018-2019 academic year

Figure 7 presents a more detailed report for graduate students versus those enrolled in that academic year. In the academic year 2018-2019 in the third year are enrolled 18 students of which only 13 of them have graduated.

V. CONCLUSION

This study presents a contribution in the field of data visualization, with a focus on higher education data. This involves designing and creating a data set, which will be used in data visualization using various visualization techniques. This is about doing data visualization for those who want to have knowledge of the data, interpret it and make decisions from the data. Data visualization can improve the use of data in higher education. A variety of different types of stakeholders in the higher education community routinely use data to make decisions. Pedagogues look at student performance data to identify knowledge, gaps, and then adjust syllabi according to instructions. Administrators look at registrations to determine courses and create schedules.

Decision making is timely as in different academic years the pedagogue improves the syllabus of the course by influencing the performance of students. This is noticed in this study where in the years 2018-2021 the performance of students is higher compared to the years 2017-2020. On the other hand, the management through the improvement of the marketing campaigns has made the number of students in the same years as above to be constant. This is because in the academic year 17-18 in the program of

implemented Informatics study in the first year are registered 10 students, in the academic year 18-19 in the first year are registered 14 students, in the academic year 19-20 are registered 15 students and in the academic year 20-21, 16 students are enrolled in the first year. As we can see, there is not much difference, but as we have pointed out in section 4, according to an instruction of the Ministry of Education, the right to higher studies have students who finish high school with an average above 6.5, added here the number of graduates who every year is declining according to the institute of statistics and a good part of them apply to study abroad, factors that have influenced the number of enrollments each academic year.

Through the visualization of data in our study we make an analysis of student results, their enrollment and graduation. The analysis performed leads us to make decisions, both by professors and university administrators. Data visualization in data analysis has a significant impact on the accuracy of the predicted results.

REFERENCES

[1] Zentner, Aeron and Covit, Raissa and Guevarra, Daniela, (2019). Exploring Effective Data Visualization Strategies in Higher Education Available at SSRN: https://ssrn.com/abstract=3322856 or http://dx.doi.org/10.2139/ssrn.3322856

[2] Mohd, Maseri & Abdullah, Embong & Mohamad Zain, Jasni. (2010). A Framework of Dashboard System for Higher Education Using Graph-Based Visualization Technique. 87. 55-69. 10.1007/978-3-642-14292-5_7.

[3] Donohoe, David & Costello, Eamon. (2020). Data Visualisation Literacy in Higher Education: An Exploratory Study of Understanding of a Learning Dashboard Tool. International Journal of Emerging Technologies in Learning (iJET). 15. 115. 10.3991/ijet.v15i17.15041.

[4] Shabdin, Nur & Yaacob, Suraya & Sjarif, N.N.A.. (2020). Relationship Types in Visual Analytics. 1-6. 10.1145/3397125.3397127.

[5] Klein, C., Lester, J., Nguyen, T., Justen, A., Rangwala, H., & Johri, A. (2019). Student Sensemaking of Learning Analytics Dashboard Interventions in Higher Education. Journal of Educational Technology Systems, 48(1), 130–154. https://doi.org/10.1177/0047239519859854.

[6] Akanmu, Semiu & Jamaludin, Zulikha. (2016). Designing Information Visualization for Higher Education Institutions: A pre-design study. Journal of Information and Communication Technology. 15. 145 - 163. 10.32890/jict2016.15.1.7.

[7] Zotov, Vladimir & Ibrahim, Iman & Petunina, Irina & Lazareva, Yuliya. (2021). Engagement of Students in Data Visualization for the Purpose of E-Learning Improvement. International Journal of Emerging Technologies in Learning (iJET). 16. 46. 10.3991/ijet.v16i02.18745.

[8] Alberto Ferrari, Marco Russo, Introducing Microsoft Power BI, Pearson Education, 2016 ISBN 1509302751, 9781509302758.

[9] Eberhard, K. (2021). The effects of visualization on judgment and decision-making: a systematic literature review. Manag Rev Q. https://doi.org/10.1007/s11301-021-00235-8.
[10] Gandhi, Parul & Pruthi, Jyoti. (2020). Data Visualization Techniques: Traditional Data to Big Data. 10.1007/978-981-15-2282-6_4.
[11] Besançon, Lonni & Cooper, Matthew & Ynnerman, Anders & Vernier, Frederic. (2020). An Evaluation of Visualization Methods for Population Statistics Based on Choropleth Maps.
[12] Balla, D.; Zichar, M.; Tóth, R.; Kiss, E.; Karancsi, G.; Mester, T. Geovisualization Techniques of Spatial Environmental Data Using Different Visualization Tools. Appl. Sci. 2020, 10, 6701. https://doi.org/10.3390/app10196701.
[13] Fisher, Christian & Andersen, Fredrik & Darbyshire, Cole. (2021). Overview of Data Visualization.

Overcome Systemic Barriers and Achieve Success on Historical Injustices on Affirmative Action Perspective

Desantila HAJRULLA[*]

Gledia HAJRULLA[2]

Shkelqim HAJRULLA[3]

[1]Departmen of Business/Faculty of Economics, University Reald, Albania
[2]Department of Political Science and International Relations /Faculty of Law, Epoka University, Albania
[3]Department of Computer Engineering /Faculty of Engineering, Epoka University, Albania
[*](didilhas@gmail.com)

ABSTRACT

The goal of affirmative action is to provide equal access to education, employment, and other opportunities to people who have been traditionally excluded. It is a set of initiatives, including programs, and procedures, that are designed to promote access to education, employment, and business opportunities for people historically excluded and underrepresented groups. The primary intention of affirmative action is to offset the effects of past discrimination and to create a level playing field for those who have been disadvantaged by historic injustices. At its core, affirmative action is intended to create an environment of fairness and to ensure that individuals are judged based on their individual merits and accomplishments, rather than on their race, gender, or other characteristics. Finally, it will examine the arguments against affirmative action, including the idea that it leads to reverse discrimination and that it undermines the notion of a merit-based society.

Keywords – injustices, affirmative action, business, barriers, inequality, employment

I. INTRODUCTION

Affirmative action has been a controversial topic since its inception in the 1960s. It refers to policies that seek to rectify the effects of past discrimination by providing special privileges to people from historically oppressed groups. The goal of affirmative action is to provide equal access to education, employment, and other opportunities to people who have been traditionally excluded. It is a set of initiatives, including programs, and procedures, that are designed to promote access to education, employment, and business opportunities for people historically excluded and underrepresented groups. The primary intention of affirmative action is to offset the effects of past discrimination and to create a level playing field for those who have been disadvantaged by historic injustices. At its core, affirmative action is intended to create an environment of fairness and to ensure that individuals are judged based on their individual merits and accomplishments, rather than on their race, gender, or other characteristics. Through the use of affirmative action, individuals have the opportunity to access occasions that were previously unavailable to them due to systemic discrimination. This is important in order to create a fair and equitable society, in which everyone has an equal chance to succeed.

On the one hand, some people argue that affirmative action policies are a form of reverse discrimination, while on the other hand, others contend that affirmative action is a necessary corrective measure to address the long history of discrimination against minorities and historically disadvantaged groups.

II. Materials and Method

2.1 Literature Review

Programs for affirmative action in the workplace aim to eliminate or lessen historical patterns of employee harassment based on demographic differences (Harrison, Kravitz, Mayer, Leslie & Lev-Arey, 2006; Resendez, 2002). They expand the number of members of historically marginalized groups in places where they have been prevalent (Resendez,2002). Because they provide personnel inside an organization the responsibility of keeping an eye on the problem, these programs also help organizations identify persistent social injustices. This is accomplished by methodically gathering pertinent data, looking for tendencies in the data collected, figuring out what caused the pattern, and resolving the issue (Crosby, Iyer & Sincharoen, 2006).

This literature review will explore the topic of whether affirmative action is a fair way to address historical injustice. First, it will provide an overview of the development and implementation of affirmative action policies in the United States. Second, it will discuss the arguments in favor of affirmative action, including the idea that affirmative action is needed to compensate for centuries of institutionalized discrimination and to ensure that all individuals have the opportunity to succeed. Using some mathematical models we can see it growing statically and calculate approximations in statistical data as in (S Hajrulla & A Uka, L Ali, 2022). Finally, we use one method for getting results through methods used in previous article (S Hajrulla & A Uka, T Demir, F Hoxha, 2022) and some statistical data of math economics applications (S Hajrulla & G Hajrulla 444). It will examine the arguments against affirmative action, including the idea that it leads to reverse discrimination and that it undermines the notion of a merit-based society.

2.2 The origin of affirmative action

The origin of affirmative action in the United States can be traced back to the Civil Rights Act of 1964, which prohibited discrimination in employment and education. Since then, affirmative action policies have been implemented in various forms, including the use of quotas, preferential hiring, and the consideration of race and gender in college admissions. This policy was implemented in the United States in the 1960s, and has since been a controversial topic in the public eye. The history of affirmative action begins in the 1960s with President John F. Kennedy's Executive Order 10925, which prohibited discrimination in the workplace based on race, creed, color, or national origin. This order paved the way for Title VII of the 1964 Civil Rights Act, which added gender to the list of protected classes. Title VII enabled the

federal government to “take affirmative action” when it came to employment decisions, in order to remedy discrimination and ensure equal opportunity for all. This was followed by the 1965 Voting Rights Act and the 1968 Fair Housing Act, which further reinforced the concept of affirmative action. Numerous studies have shown that these policies have had a positive effect, especially in terms of increasing the number of women and minorities in higher education and in the workplace.

III. RESULTS

The main argument in favor of affirmative action claims that it is a necessary tool to address the legacy of historical injustices and discrimination. Proponents argue that affirmative action is an effective way to level the playing field and to ensure that all individuals have the opportunity to succeed. They point to the fact that African Americans, Latinos, and other minority groups have been disproportionately affected by a history of prejudice and discrimination, and that affirmative action policies can help to right these wrongs. On the other hand, opponents of affirmative action argue that it is unfair and can lead to reverse discrimination. They contend that affirmative action policies favor certain races and genders over others, which undermines the notion of a merit-based society. Additionally, they argue that affirmative action policies can be used to punish individuals who are not responsible for historical injustices.

The contention that was at the heart of the Michigan instances was that affirmative action is necessary to ensure the heterogeneity of school systems and workforces (Miller 1997). Affirmative action's contribution to ensuring fair recruitment processes and decisions is a further justification. This position was included in the American Psychological Association's advisory opinion in the Michigan cases and has particular significance to public discussions (e.g., Crosby & Clayton 2004, Crosby et al. 2003).

Affirmative action, according to critics, is essential in order to diversify American companies and schools (Tierney 1997). The proof that affirmative action helps ethnic minorities get a chance to attend college up until recently included analyzing admission trends over time and was therefore, at best, speculative (Allen et al. 2003, Crosby & Clayton 2004). But in 1998, former Princeton and Harvard University presidents William Bowen and Derek Bok wrote the ground-breaking book The Shape of the River (Bowen & Bok 1998). Their work offered the first comprehensive quantitative analysis of the effects of affirmative action.

A recent review of data for around 27,000 students who were accepted to approved law schools in 1991 and were followed throughout law school and beyond contrasts with the claim that affirmative action helps promote diversity (Sander 2004). The statistics revealed that African Americans were significantly less likely than whites to graduate law school or pass the examination and that they selected higher-tier law schools than whites with equivalent qualifications. Introductory credentials had a strong correlation with class ranking, which helped forecast graduation and the probability of passing the bar. Recognizing the historical significance of race-conscious admissions practices, according to Sander's findings, less African Americans graduate from law school and take the exam as an outcome of race-sensitive admissions practices than would be the case with race-neutral ones. According to Sander, African American law students would be less likely to drop out of school if they were in the center of their course at a fairly low law school rather than at the bottom, as they currently are, in a higher-tier law school.

In this essay, I will discuss why affirmative action is a fair way to deal with historical injustice. I will examine the legal and moral justification for affirmative action, as well as the benefits of these policies, in order to make a compelling argument in favor of the topic.

First, affirmative action is a necessary step to ensure that historically marginalized groups are given an equal chance to succeed. Despite great strides towards equality in recent decades, many people still face systemic discrimination. Women and people of color are often passed over for promotions and job opportunities due to their gender or race. Affirmative action seeks to level the playing field by providing special privileges to these groups, such as preferential hiring practices and access to scholarships.

Second, affirmative action is an effective way to address the legacy of past discrimination. While there are no easy solutions to undo the damage caused by centuries of inequality, affirmative action is one way to reduce the gap between the privileged and the marginalized. By providing additional resources to historically disadvantaged groups, affirmative action offers them a chance to overcome systemic barriers and achieve success.

Third, affirmative action is a mean to guarantee that everyone has a chance to contribute to their community. When people from all backgrounds have access to the same opportunities, they can bring a variety of perspectives to the table. This diversity of ideas and experiences can help foster an environment of innovation and progress and to level the playing field in order to give those who have been discriminated against a better chance of success. By

implementing affirmative action policies, employers can demonstrate that they are committed to creating an equitable workplace.

IV. DISCUSSION

This First off, alternative access programs (AAPs) have been used in South Africa to incorporate disadvantaged student groups, particularly black female students. Additionally, the nation offers beneficial programs and advisors to guarantee the professional achievement of these student groups.

Equal to this, India's constitution-makers and tribunals have adopted positive policy measures to guarantee an equitable society and eradicate the social injustices of segregation and discrimination. Consequently, constitutional protection has paved the way for stronger coverage and development of many disadvantaged classes in terms of education, public service careers, and promotional chances.

While affirmative action policies are a reasonable system to mark historical injustices, they can also have unintended consequences. Affirmative action policies may lead to reverse discrimination against white males, who are often seen as the primary beneficiaries of preferential treatment. There is a risk that it could even lead to increased social tensions (Lynch 1992). One of the major criticisms of this action is that it effectively discriminates against those who do not belong to the group that it is intended to benefit. For example, when universities set quotas for the number of students from particular backgrounds, it could lead to those from other backgrounds having their applications unfairly overlooked. This could have a long-term effect on the prospects of those affected, and could lead to feelings of antipathy and mistrust amongst different sections of society. Affirmative action policies can also be viewed as unfair or even racist if they are not properly implemented. Furthermore, these policies can create a competitive disadvantage for non-minority candidates who might otherwise be well qualified. They can be used to further the interests of those in power, rather than to benefit those who have been historically oppressed applying math economics instructions (S Hajrulla & G Hajrulla, 2022) and using a statistical method to estimate an unknown price as in (S Hajrulla & D Osmani, V Lino, D Avdiu, D Hajrulla, 2022). For example, corporations may use it as a way to increase the diversity of their workforce and appear progressive, while not necessarily providing any meaningful opportunities to those from disadvantaged backgrounds. This could lead to a situation where those in charge are able to benefit from the policy, while those it is intended to help remain marginalized.

Affirmative action critics frequently criticize the practice as unjust, arguing that it undermines the United States' valued concept of meritocracy by centering hiring decisions on demographic factors instead of capacity and

performance (Thernstrom & Thernstrom 1997, Zuriff 2004). Supporters adopt a distinctly different position. At the most fundamental level, they question why many other widespread behaviors that undermine the meritocracy are not criticized but affirmative action is picked for criticism. Universities, for instance, develop extensive justifications as to why legacy students are three to four times more likely to get admitted than other applicants (Guerrero 1997,Rhode 1997). Additionally, some university players have profited from unique admissions standards despite evidence that institutions may not make money off of their athletics departments (Bowen & Levin 2003). Consequently, rather than being based on meritocracy, staffing decisions in workplace settings are frequently made based on habit (Crosby et al. 2003) or commercial needs.

Depending on how the method and the concept are presented or interpreted, different people have different perceptions affirmative action. Outreach programs and other "friendly" types of affirmative action are preferred to "strict" versions, such as schemes that use gender or ethnicity as a deciding component in recruitment choices (Kravitz 1995; Kravitz & Klineberg 2000, 2004; Kravitz & Platania1993; Nosworthy et al. 1995). Affirmative action is generally disliked more by those who believe it to be a quota system, a structure of gender or ethnic favors. Individuals who have been convinced that affirmative action takes into consideration quality are more likely to agree with the policy than other people. In principle, a technique is ranked higher when it is thought to be impartial. Aberson (2003) discovered that when the justifications for the program were given, both individuals of color and white people enhanced their approval for it. Few scholars have studied how various defenses or justifications affect people's perceptions of affirmative action.

V. CONCLUSION

In conclusion, affirmative action is a complicated subject that requires understanding and empathy on both sides of the debate. Supporters of affirmative action argue that it is a crucial apparatus to address ongoing discrimination in the workplace and to promote diversity in educational institutions. Opponents of affirmative action believe that it is an unfair form of reverse discrimination and that it should not be used to prioritize certain groups over others. Ultimately, the decision to use affirmative action rests with the government and employers, who must balance the need to promote fairness with the need to prevent potential abuses. Despite the debate surrounding affirmative action, it is clear that it is still a necessary tool for addressing the effects of historical injustices. While it may not be perfect, affirmative action can help to ensure that everyone has an equal opportunity for success and can help to create a more diverse and equitable society. Affirmative action is a necessary step to combat the legacy of historical

injustice. It is a fair way of addressing the disadvantages that certain groups have faced in the past, and it is often the only way to ensure that those who have been systematically oppressed can have the same chances as everyone else. As an important tool for creating a more equitable society, it is essential that we continue to use it to promote equality and justice. Although some may argue that affirmative action can lead to reverse discrimination, the evidence suggests that it is an important and effective instrument for achieving greater equality. Affirmative action policies may not always be enough to help corporations and colleges reach their diversification and inclusion objectives.

Affirmative action policies that are poorly designed might really lead to harm. For a variety of intentions, paying attention to good implementation is crucial

REFERENCES

[1] Fryer Jr., R.G. and Loury, G.C. (no date) Affirmative action and its mythology, Journal of Economic Perspectives. Available: at: https://www.aeaweb.org/articles?id=10.1257%2F089533005774357888

[2] Fullinwider, R. (2018) Affirmative action, Stanford Encyclopedia of Philosophy. Stanford University. Available: https://plato.stanford.edu/entries/affirmative-action/

[3] Cahn, S. M. (2013). The affirmative action debate. Routledge.

[4] Mark C. Long et al. (2003) "College applications and the effect of affirmative action", *Journal of Econometrics. North-Holland.*Available: https://www.sciencedirect.com/science/article/pii/S0304407603002513

[5] Blanchard, F. A., & Crosby, F. J. (2012). "Affirmative action in perspective". Springer Science & Business Media, 2012.

[6] Sterba, J. (2011). "Affirmative action for the future". Cornell University Press, 2011.

[7] Spann, G. A. (1995). Affirmative Action and Discrimination. Howard LJ, 39, 1.

[8] S Hajrulla, A Uka, L Ali, "*The role of the correct use of scientific language and scientific researches in improving the English language in universities. The relationship between English learning and research writing*" – Proceedings. Innovation in Language Learning, 2022

[9] S Hajrulla, G Hajrulla. "*A Survey and Statistical Data of Math Economics Applications International Relations Triple-Purpose*", Procceding book 444.

[10] S Hajrulla, A Uka, T Demir, F Hoxha, D Hajrulla, L Bezati, "Unimodular matrix on shallow water wave theory. Unimodularity through matrix method", *New trends in Mathematical Sciences.* 10 (1), 25-31 (2022)**.**

[11] Harrison DA, Kravitz DA, Mayer DM, Leslie LM, Lev-Arey D. "*Understanding attitudes toward affirmative action programs in employment: summary and meta-analysis of 35 years of research*". J Appl Psychol. 2006 Sep;91(5):1013-36. doi: 10.1037/0021-9010.91.5.1013. PMID: 16953765.

[12] Crosby, F. J., & Smith, A. E. (2007). The University of Michigan cases: Social scientific studies of diversity and fairness. In R. L. Wiener, B. H. Bornstein, R. Schopp, & S. L. Willborn (Eds.), *Social consciousness in legal decision making: Psychological perspectives* (pp. 121–142). Springer Science + Business Media. https://doi.org/10.1007/978-0-387-46218-9_6

[13] S Hajrulla, D Osmani, V Lino, D Avdiu, D Hajrulla "A Statistical Method to Estimate An Unkonown Price in Financial Markets" - *PROCEEDINGS BOOK, 2022*

[14] Crosby, R. D., Kolotkin, R. L., & Williams, G. R. (2003). Defining clinically meaningful change in health-related quality of life. *Journal of clinical epidemiology*, *56*(5), 395-407.

[15] Kravitz, D. A., & Klineberg, S. L. (2000). Reactions to two versions of affirmative action action among Whites, Blacks, and Hispanics. *Journal of Applied Psychology, 85*(4), 597–611. https://doi.org/10.1037/0021-9010.85.4.597

[16] Aberson, C.L. (2003). Support for race-based affirmative action: Self-interest and procedural justice. *Journal of Applied Social Psychology*, 33(6), 1212-1225.
[17] S Hajrulla, G Hajrulla. "Applying Math Economics Instructions on International Relations e", *Procceding book 345.*

[18] Bowen, N. J., Jordan, I. K., Epstein, J. A., Wood, V., & Levin, H. L. (2003). Retrotransposons and their recognition of pol II promoters: a comprehensive survey of the transposable elements from the complete genome sequence of Schizosaccharomyces pombe. *Genome research*, *13*(9), 1984-1997.