

# Effects of gender and cognitive style on students' learning retention in social studies using computer-based instructional puzzle

JUBRIL B. FAKOKUNDE

Department of Science, Technology and Mathematics Education  
Osun State University  
Nigeria  
jubril.fakokunde@uniosun.edu.ng

## ABSTRACT

*The need to promote learning retention through the adoption of techniques that enhance active participation of the learners in the teaching learning process has resulted into the design of computer-based instructional puzzle in social studies in this study. However, gender and cognitive style have been found to influence learning premised on the technique adopted in the instructional delivery. The study therefore investigated the effects of gender and cognitive style on secondary school students' learning retention in social studies. The study adopted a pretest-posttest and delayed-test quasi-experimental design. Four junior secondary schools were purposively selected within Ilesa metropolis of Osun State. Intact class was used in each of the schools and a total of 141 participants were involved. The instruments for data collection were Social Studies Achievement Test, Cognitive Style Checklist and Computer-based Instructional Puzzle. Three research questions were answered. The result showed that gender does not affect students' learning retention in social studies. It further revealed that cognitive style does not affect students' learning retention in social studies. It also revealed lack of combined effect of gender and cognitive style on students' learning retention in social studies. Premised on the findings, the researcher recommended the adoption of computer-based instructional puzzle in the teaching and learning of social studies.*

## KEYWORDS

*Cognitive Style, gender, instructional puzzle, retention, Social Studies*

## RÉSUMÉ

*La nécessité de promouvoir la rétention de l'apprentissage grâce à l'adoption de techniques qui améliorent la participation active des apprenants dans le processus d'enseignement et d'apprentissage a abouti à la conception d'un puzzle pédagogique informatisé en sciences humaines dans cette étude. Cependant, il a été constaté que le sexe et le style cognitif influent sur l'apprentissage fondé sur la technique adoptée dans la prestation de l'enseignement. L'étude a donc examiné les effets du sexe et du style cognitif sur la rétention d'apprentissage des élèves du secondaire en sciences humaines. L'étude a adopté une conception quasi-expérimentale prétest-post-test et retard-test. Quatre écoles secondaires de premier cycle ont été sélectionnées à dessein dans la métropole d'Ilesa, dans l'État d'Osun. Une classe intacte a été utilisée dans chacune des écoles et un total de 141 participants ont été impliqués. Les instruments de collecte de données étaient le test de réussite en études sociales, la liste de contrôle du style cognitif et le puzzle pédagogique informatisé. Trois questions de recherche ont reçu une réponse. Le résultat a montré que le sexe n'affectait pas la rétention*

*d'apprentissage des élèves en sciences humaines. Il a en outre révélé que le style cognitif n'affectait pas la rétention d'apprentissage des élèves en sciences humaines. Elle a également révélé l'absence d'effet combiné du sexe et du style cognitif sur la rétention d'apprentissage des élèves en sciences humaines. Sur la base des résultats, le chercheur a recommandé l'adoption de casse-tête pédagogique informatisé dans l'enseignement et l'apprentissage des études sociales.*

## **MOTS CLÉS**

*Style cognitif, genre, puzzle pédagogique, rétention, études sociales*

## **INTRODUCTION**

Students' achievement in any academic endeavour is premised on the ability to learn, retain and recall learning experiences. Any experience not retained cannot be recalled when the need arises. Therefore, retention is fundamental to academic achievement thereby making the use of relevant strategies and materials that could facilitate retention germane in the teaching-learning process. According to Amin and Malik (2014), factors affecting retention include rehearsal, exercise, testing and reward. The scholars posit that rehearsal entails repeated reception of the same content, events and information through verbal or visual means. In the view of Terada (2017), the use of text with images coupled with frequent practice test could facilitate the retention of what has been learnt.

In the view of Goins and Fisher (2018), using spacing and spaced repetition, active involvement of the learners in the teaching-learning process, stimulation of multiple senses via the use of images as well as addition of elements of taste, smell and touch are capable of enhancing retention. Parrot (2019) identifies practice as one of the factors that could improve the ability of a child to recall which goes in line with Lynch (2020). The above postulations reveal that adopting techniques and materials that allow students to practice would promote retention thereby resulting into improved academic achievement.

One of the techniques that allows learners to get involved actively and practice repeatedly is the adoption of instructional puzzles. Scott (2002) defines puzzle as nothing but a problem that is fun to solve. Adodo and Ogundare (2016) citing Becky (2010) view puzzles as game or problems that require careful thinking in order to solve or answer. The scholar found significant effect of puzzle-based instructional strategy on students' achievement in basic science which attests to Olagunju and Babayemi (2014). Thomas et al. (2013) while referring to mathematics reveal that the use of puzzle in the teaching-learning process helps in developing the problem-solving and independent-learning skill of the learners. Adedoja, Abidoje and Afolabi (2013) reveal significant effect of puzzle-based learning on students' academic performance in social studies using three dimensional puzzle-based strategy, and paper and pencil puzzle-based strategy. Cardozo et al. (2016) admit that the use of puzzle based strategy improves university students' learning of key topics in cardiovascular physiology premised on its interactivity, fun and inbuilt formative evaluation. Dzulfilkri (2016) reveals that crossword puzzle has positive effect on vocabulary retention of students in English language and also spurs their curiosity to learn new vocabulary. Omur and Said (2019) reveal that puzzle promotes fun, enhances collaborative learning environment and also challenges the learners to test their knowledge. The authors reveal the effectiveness of puzzle in teaching vocabulary among young language learners.

HariPriya (2019) asserts that game-based learning environment promotes the retention rate of students in understanding pathology. Patel and Dave (2019) posit that games and puzzles are forms of active learning strategies that could be helpful in reviewing,

summarizing and developing new relationship among concepts. The scholars acknowledge the attribute of puzzle-based learning in promoting learners' competent in understanding the basic concepts in complex topic and apply it in future learning process. Patel et al reveal students' preference for puzzle-based learning and its attribute of promoting recall. Derer and Berkant (2020) revealed that puzzle-based learning has significant effect on students' general English language skills and their ability to write which was attributed to the fun inherent in the use of puzzle for learning and the promotion of active participation of the learners in the learning process.

The study of Agarwal, Singhal and Yadav (2020) reveals students' preference for puzzle-based learning. It further reveals that using puzzle improves the memory power, performance and critical thinking ability of the learners. The finding goes in line with Stavy, Subon and Unin (2019) which reveal that using language games which include the use of puzzle-based learning improves vocabulary retention among primary school pupils. The above show that puzzle-based learning is effective in promoting students' academic achievement. However, the use of computer-based instructional puzzle technique which could be relevant in instructional delivery and make the learners relevant in the global village has not been given due attention,

The application of computer in different aspects of human endeavours, particularly in the realm of information dissemination and retrieval coupled with the commitment of students to the use of computer based devices have made computer relevant in the teaching-learning process. Scholars in the field of education have researched on the efficacy of computer-based instructional strategy on academic achievement. Mihindo, Wachanga and Anditi (2017) affirm significant effect of computer-based simulation on secondary school students' achievement in chemistry. Chirco (2018) also find significant positive effect of computer-based instruction on students' learning. Sedega et al. (2017) reveal positive effect of computer assisted instruction on students' achievement in pie chart and histogram aspects of mathematics. Abdullahi, Yusuf and Mohammed (2018) confirm the efficacy of computer-based learning in promoting students' academic achievement and retention. On the part of Eche and Okorie (2018), computer-based instructional media has positive effect on students' academic achievement in fine arts while Koni, Zephaniah and Okoro (2019) show the effectiveness of computer-based instructional package in arithmetic progression aspect of mathematics at secondary school level.

In spite of the relevance of puzzle-based learning and computer based instructional strategies in facilitating learning, there are some variables such as gender and cognitive style which could affect the success of their adoption in the teaching-learning process. Gender has been viewed as a range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between the feminine and masculine population. Gender also has a form of socio-cultural dimension in term of role and expectations which create a dichotomy between male and female children in their training and allocation of responsibilities which could also affect their academic achievement premised on the strategies adopted in the teaching-learning process.

According to Filgona and Sababa (2017), there is a significant effect of gender on students' achievement in geography using mastery learning strategy with the female on the higher side. The study conducted by Owodunni and Ogundola (2013) shows significant effect of gender on students' retention in electronic works trade using reflective inquiry technique with the female learners on the higher side. Ogundola, Agboola and Ogunmilade (2020) also attest to the significant effect of gender on retention in fabrication and welding engineering craft practice e using computer assisted instructional technique. However, Ezeudu (2013) asserts no significant effect of gender on learning retention in organic chemistry using concept maps instructional technique. The finding is in consonance with Ajai and Imoko (2015),

which revealed no significant effect of gender on learning retention in algebra using problem-based learning thereby aligning with Gumel and Galadima (2014) in their study on geometry using problem solving approach. The study of Nwoye, Okeke and Nwosu (2020) further affirms no significant effect of gender on students' learning retention in physics using animated instructional package. The inconsistency in the findings of scholars on the effect of gender on learning retention makes it relevant as a variable in this study.

Aside gender, cognitive style could also predict students' academic achievement and retention thereby making it a relevant variable when adopting any instructional strategy in the teaching-learning process. Cognitive style has been defined as individual's preferred means of receiving, processing and making use of information. Therefore, cognitive style could predict students' learning outcome in relation to any instructional strategy adopted. According to Agboghroma (2015), cognitive style has significant effect on students' knowledge in integrated science in relation to the instructional mode adopted in the teaching-learning process thereby making its consideration germane in the selection of instructional technique. The study conducted by Rongbin (2017) also reveals significant effect of cognitive style on students' learning retention when it involves determining the structure of complex information arrangement. The study shows that field-independent learners are better opportune in such a task than the field-dependent.

Atsuwe and Mtoh (2019) also attest to significant effect of cognitive style on the ability of the learners to retain what they have learnt. The scholars found that field-independent learners were able to retain what they learnt in physics class than the field dependent. The study of Arifin et al. (2020) also lays credence to the significant effect of cognitive style on the ability of students to retain learning experiences. The scholars found significant effect of cognitive style on students' critical thinking ability and retention with the field-independent learners on a higher level.

According to Olagbaju (2020), both cognitive style and gender are predictors of students' academic achievement which attests to Adesina, Adegboke and Ogundiwin (2015). Sharma and Ranjan (2018). Musa and Samuel (2019) also attest to the postulation. The above findings on the effect of gender and cognitive style necessitate this study.

## **STATEMENT OF THE PROBLEM**

The need to adopt instructional strategies that can promote the ability of the learners to retain relevant experiences acquired in the teaching-learning process requires the adoption of instructional strategy that can stimulate the learners' critical thinking ability, allow the learners to practice repeatedly with element of fun which could reduce or remove the tension associated with traditional instructional strategy cannot be under estimated. The drive to promote retention of learning experiences in social studies through the adoption of socially relevant strategy warranted the adoption of computer-based instructional puzzle in this study since learners of this millennium have been categorized as digital native based on their comportment in using computer-based devices. However, the effect of gender on role expectation and allocation which tend to influence the choice of school subjects and acceptance of instructional technique requires its proper consideration in the selection and adoption of any instructional technique. Furthermore, the effect of cognitive style on the way different individuals receive, process and make use of information calls for its consideration in the selection and use of any instructional technique. This study therefore investigated the effect of gender and cognitive style on retention using computer-based instructional puzzle.

## RESEARCH QUESTIONS

1. Does gender affect students' retention in social studies using computer-based instructional puzzle?
2. Does cognitive style affect students' retention in social studies using computer-based instructional puzzle?
3. Is there a combined effect of gender and cognitive style on students' retention in social studies using computer-based instructional puzzle?

## METHODOLOGY

The study adopted a pretest-posttest and delayed-test quasi-experimental design. Four schools were purposively selected within Ilesa metropolis in Osun State premised on the availability of qualified social studies teacher and functional computer laboratory. Students in two of the selected schools formed the experimental group while the others served as the control group. The experimental group was exposed to computer-based instructional puzzles for eight weeks based on selected topics from junior secondary school 11 social studies curriculum while conventional method was used in the control group. Intact class was used in each of the schools with a total of 141 participants. Pretest was carried out before the commencement of the treatment and posttest was conducted after the treatment while delayed test was administered in the 3<sup>rd</sup> week after the posttest.

The instruments for data collection are Computer-Based Instructional Puzzle (CBIP), Social Studies Achievement Test (SSAT) and Cognitive Style Checklist (CSC). The Social Studies Achievement Test consisting 50 items was given to lecturers in social studies education and social studies teachers at junior secondary school for face and content validity. The instrument was also administered to 25 students in a school that was not included in the study. The students' responses were subjected to Kuder-Richardson formula (KR 21) and a reliability coefficient of 0.89 was obtained. The Cognitive Style Checklist was used to categorise the participants into field independent, field dependent and field neutral. It consists 12 items based on the modified form of Wyss (2002) checklist with each having options "a" and "b". Participants were expected to choose option that best describes them in terms of preferred mode of learning. A participant that chooses up to eight option "a" is regarded as field independent, those with up to eight "b" are regarded as field dependent while those who do not fall within the stipulated conditions are field neutral. The instrument was administered to 25 students who were not part of the study but shared the same characteristics with the participants and a reliability coefficient of 0.75 was obtained through split-half method. Data collected at pretest, posttest and delayed-test were analysed using Analysis of Covariance (ANCOVA).

## RESULTS

Table 1 reveals that there is a significant main effect of treatment on students' retention scores in social studies ( $F_{(1,128)} = 111.85$ ;  $P < 0.05$ ). However, the table shows that gender did not affect students' learning retention in social study based on the use of computer-based instructional puzzle ( $F_{(1,128)} = 0.31$ ;  $P < 0.05$ ). The table also reveals that cognitive style did not have any noticeable effect on students' learning retention premised on the use of computer-based instructional puzzle ( $F_{(1,128)} = 0.914$ ;  $P < 0.05$ ). The table also shows that gender and

cognitive style did not have significant effect on students' learning retention in social studies ( $F_{(2,128)} = 1.409$ ;  $P < 0.05$ ).

**TABLE 1**  
*Analysis of Covariance (ANCOVA) on Students' Retention Scores in Social Studies*

Source	Type III Sum of Square	df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	5009.836	12	417.486	13.516	.000	.559
Intercept	5953.571	1	5953.571	192.739	.000	.601
PREACHV	475.429	1	475.429	15.391	.000	.107
TREATMT	3454.800	1	3454.800	111.845	.000*	.466
SEX	9.566	1	9.566	.310	.579	.002
COGSTY	56.463	2	28.231	.914	.404	.014
TREATMT * SEX	13.742	1	13.742	.445	.506	.003
TREATMT * COGSTY	80.892	2	40.446	1.309	.274	.020
SEX * COGSTY	87.065	2	43.532	1.409	.248	.022
TREATMT * SEX * COGSTY	38.568	2	19.284	.624	.537	.010
Error	3953.824	128	30.889			
Total	124777.000	141				
Corrected Total	8963.660	140				

\*Significant at  $P < 0.05$

a. R Square = .559 (Adjusted R Square = .518)

To find the group that is significant, the post-achievement scores of the students across the groups is presented on Table 2.

Table 2 reveals that students exposed to computer-based instructional puzzle have higher retention mean score (32.63 [65.3%]) than their counterparts in control groups (21.69 [43.4%]); the difference between them is statistically significant. However, the mean scores of (27.45) and (26.87) for male and female participants in the study show that gender did not contribute to the ability of the participant to retain what they have learnt through the use of the instructional package. The table also reveals the mean scores of field dependent, field independent and field neutral as (27.65), (27.64) and (26.19) respectively. The above mean scores in relation to cognitive style imply that cognitive style did not have noticeable effect on students' learning retention using computer-based instructional puzzle.

**TABLE 2**  
*Estimated Marginal Means on Students' Retention Scores in Social Studies*

Variable	N	Mean	Std. Error
Pre-score Achievement	141	19.02	-
Post –score Retention	141	27.16	.52
<i>Treatment</i>			
Control	53	21.69	.83
Experimental	88	32.63	.62
<i>Gender</i>			
Male	85	27.45	.68
Female	56	26.87	.78
<i>Cognitive style</i>			
FI	59	27.65	.76
FD	36	27.64	1.03
FN	46	26.19	.89

The mean scores for the experimental (computer-based instructional puzzle) and for the control group (traditional mode of instruction) are 32.63 and 21.69 respectively. This further shows the efficacy of the computer-based instructional puzzle in enhancing students' learning retention without attributing it to the difference the learners' gender or cognitive style.

## DISCUSSION OF FINDINGS

The study revealed that gender has no significant effect on students' retention in social studies. This implies that gender as a variable did not account for the significant effect of treatment on retention in this study. This finding is in consonance with Ajai and Imoko (2015), Ezeudu (2013), Gumel and Galadima (2014), and Nwoye et al. (2020) but runs contrary to Ogundola et al. (2020) and Owodunni and Ogundola (2013). The fact that gender has no significant effect shows that the instructional puzzle developed in this study is not inclined to influence learning towards a particular gender thereby attesting to the suitability in instructional delivery.

The study also reveals that there is no significant main effect of cognitive style on students' retention in social studies. This implies that the noticeable improvement in students' retention was not due to the cognitive style of the learners. The finding contradicts Agboghroma (2015), Arifin et al. (2020), Atsuwe and Mtoh (2019) and Rongbin (2017) which found significant effect of cognitive style on learning retention based on the adoption of different instructional techniques. The cognitive style neutrality of the instructional package implies that the package could be used to enhance learning retention of students of diverse cognitive styles.

On the interaction effects of gender and cognitive style, the study found no significant interaction effect of the variables on retention. Though the findings of Adesina et al. (2015), Musa and Samuel (2019), Sharma and Ranjan (2018), and Olagbaju (2020) asserted interaction effect of gender and cognitive style on students' achievement, this study did not find such in term of learning retention. This implies that the combined effect of gender and cognitive style did not influence students' retention in relation to the strategy thereby making its adoption in instructional delivery suitable.

## CONCLUSION

The study investigated the effect of gender and cognitive style on students' learning retention using computer-based instructional puzzle technique in social studies. A total of 141 secondary school students assigned to experimental and control groups was involved in the study. The study revealed that there is no significant effect of gender and cognitive style on secondary school students' learning retention in social studies. It further revealed that there is no significant combined effect of gender and cognitive style on students' learning retention in social studies thereby implying that computer-based instructional puzzle could facilitate the retention of learning experiences without gender and cognitive style bias.

## RECOMMENDATIONS

The following recommendations are hereby made based on the findings:

1. The use of computer-based instructional puzzles as instructional technique should be embraced in social studies.
2. Necessary facilities that are required for the adoption of computer-based instructional puzzle in the teaching-learning process should be provided in schools.

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