

Original Research Article

AWARENESS AND ATTITUDE OF SOCIAL STUDIES TEACHERS ON THE USE OF SOCIAL STUDIES APPS FOR TEACHING

Abstract

This study was aimed at assessing the awareness and attitude of social studies teachers on the use of social studies apps for enhancing students learning. It is a descriptive survey with a population of fifty social studies teachers from twenty-two public secondary schools in Khana Local Government Area of Rivers State. The entire population was used as the sample for this study. A total of five objectives, five research questions and three hypotheses guided the study. The Instrument used for data collection was a 52-item questionnaire titled: "Teachers' Awareness, Attitude and Perception Toward the Use of Social Studies App". The reliability of the questionnaire was estimated using the Cronbach Alpha method of internal consistency with an overall reliability coefficient of 0.83. Mean and standard deviation were used to answer the research questions while independent sample t-test was used to analyse hypotheses one and two, and Pearson Product Moment correlation (PPMC) was used to analyse hypothesis three. Findings revealed that Social Studies teachers are not very much aware of social studies apps, but the teachers have a positive attitude towards utilizing social studies apps for teaching. A positive but weak correlation exists between social studies teachers' awareness level and their attitude toward the use of social studies apps. Based on the findings, it was recommended that the Rivers State Government should organize seminars to raise the level of awareness of social studies teachers on the existence of apps that can be used for teaching the subject. Workshops should also be organized by the Government to assist these teachers learn how to use these apps. Above all, social studies teachers should develop positive attitude towards the use of social studies apps in the classroom.

Comment [KR1]: Please explain contribution of study clearly

Keywords: Social Studies Apps, Social Studies, Attitude, Perception, Awareness,

Introduction

To function effectively in a society, an individual needs to understand his environment. Social studies as a subject is concerned with man and his environment. As a subject, social studies gives students the opportunity to develop the knowledge, skills and attitudes (KSA) that will enable them become informed and responsible citizens and function effectively in their environment. The students become engaged and active citizens. In Nigeria, social studies as a subject was introduced into the educational system about 50 years ago (Mezieobi, Fubara and Mezieobi, 2008). Ever since its introduction, social studies has grown from

Comment [KR2]: Please provide statistics to support most of the points here. The title/topic, scope and objectives of the manuscript are adequately defined. Clear objectives and problem statement need to be discussed before the LR part. Sound work which expresses a coherent position only in broad terms and in uncritical conformity to one or more standard views of the topic

strength to strength moving from the lower, middle and upper basic education levels, colleges of education to the tertiary institutions.

As an integrative subject, social studies incorporates many fields of endeavour, and this makes the subject unique among others. It integrates knowledge from different disciplines such as geography, economics, history and political science. This knowledge is integrated in the context of the society that the individual exist in. Thus for individuals to develop civic competence, they need to study social studies. Given the importance of the subject, it becomes very crucial for social studies teachers to use the right methodology and resources to make the subject enjoyable for all learners. In a related development, Birabil and Nwankwo (2020) advised social studies teachers to go extra miles by:

- Promoting socio-civic competences in the learner;
- Developing in the learner, positive attitude and values;
- Promoting the most needed information to the learners;
- Making students to understand and apply good usage of environmental resources;
- Encourages the spirit of team work and cooperation among the students;
- Leads student explore and discover meaningful ideas;
- Prepare learners for all relational encounters in the environment; and
- Promote democratic-oriented citizens.

Looking at the nature and concept of social studies, some researchers have suggested various methods and strategies that could be effective in teaching the subject. Some of these teaching strategies include demonstration, map and illustration, inquiry, discovery, and problem solving, to mention but a few. Each of these strategies are geared towards helping learners create experiences that they can apply in their everyday life. A beautiful way of creating such learning experiences is the use of social studies apps.

Literature Review

Social studies apps are educational apps that allow students to learn outside the classroom. Thus their learning is not limited to just school time. These apps are designed to personalize learning. They allow learners go through the scheme of work at their own pace. Learners are given opportunities to explore various areas that are of interest to them. In addition, they can also practice recalling facts that strengthen their knowledge of the subject. These apps engage students, make the learning of social studies interesting and enhance students' learning of the subject (EdTechReview, 2014).

Comment [KR3]: A basic overview of the literature, with limited interpretation and application. Limited past research is presented, or research presented is not relevant to the topic. Citations are not presented in the correct format. This manuscript is moderately relevant and will make a nominal contribution to the field. Conceptual / theoretical framework should be provided as well to convey the direction of study. Some attempt to construct a coherent argument, but may suffer loss of focus and consistency, with issues at stake stated only vaguely, or theoretical mode(s) couched in simplistic terms. Relevant Theories also need to be discussed in this part.

This research is anchored on the theory of connectivism proposed by Siemens in 2005. Connectivism is called the learning theory of the digital age. The theory shows how humans make meaning of information through connections. By connecting to other humans and new technologies, students can engage in meaningful learning. When learners make connections with other learners with the use of social studies apps, they increase the frontiers of knowledge.

Social studies apps allow learners to engage in interactive assignments and activities outside the classroom environment. With these apps, learners can talk with people from different cultures, learn from them, read animated histories of different countries and cultures, and develop skills that will allow them to demonstrate global awareness, respect diversity, and be driven to social justice (Common sense media, 2017). Some of these apps contain well-designed games, lesson plans and a wealth of resources. The apps make use of multimedia and beautiful photos that engage students and make learning so much fun. The lessons are interactive and allow for collaboration among students around the world. Some of these apps include World Atlas, Social Studies Friendly, the Pyramids, iCivics, Kids planet discovery, and Stack the countries, Oregon Trail, just to mention few.

Given the interactive and engaging nature of these apps, it becomes necessary that social studies teachers should learn how to utilize these apps to enhance learning. Utilizing apps in the teaching of social studies is an aspect of ICT integration. A successful ICT integration largely depends on teachers' attitude (Hong, 2016). If teachers lack a positive attitude toward ICT integration, they would not be motivated to use social studies apps in the teaching and learning of social studies. A study carried out by Zakana and Fomsi (2019) showed that ICT integration can engage students and motivate them to learn. In the study they used two apps namely Facebook and Edmodo to engage senior secondary two (SS 2) students. Their findings revealed that students who used the apps to learn were more engaged and motivated than those who did not, with facebook app having the highest number of engaged students. Use of apps including game apps has always had a positive impact on learners' engagement at all levels from primary to tertiary level. Huang and Hew (2015) investigated the influence of game components on learners' engagement and the outcome showed that utilizing game components can effectively enhance students' engagement. Similarly, Perez (2015) cited in Ogochukwu and Fomsi (2015) employed game components for students in higher education and the findings showed that learners who learnt using games were more engaged in the lesson. Ogochukwu and Fomsi (2019) also carried out a research on the

influence of gamification on elementary pupils' engagement in English Language. Their findings showed that learners who learnt with games were more engaged than those who learnt without games and their overall learning experience was enhanced. Given these findings, it is quite obvious that utilizing technology apps can gamify the classroom, engage learners, improve performance and retention and enhance overall learning experience. Thus, it is imperative that social studies teachers develop a positive attitude towards use of technology apps. In a study by Fomsi and Anikpo (2019) on the attitude of classroom teachers toward utilizing ICT for 21st century teaching of digital natives and millennials, seventy eight (78) primary and secondary school teachers were sampled and findings showed that teachers have a positive attitude towards integrating technologies in the classroom. But do social studies teachers in Khana Local Government Area also have a positive attitude towards the use of social studies app? Are they aware of these apps? What are the perceived challenges that inhibit their use of these apps? These are the questions that this study seeks to address.

Statement of the problem

Social studies is a subject that gives students the opportunity to develop skills that will allow them to demonstrate awareness of the world around them, respect cultural diversity, possess knowledge of civic rights and be motivated to develop and demonstrate social justice. If these basic skills are not properly inculcated into the learners at an early age, there will be total chaos in the society where these learners will function. Realizing the importance of this, it becomes imperative that social studies teachers should utilize different types of teaching methods to be able to inculcate life changing skills into the learners. Given the fact that the world is now technology driven, and more and more children today tend to rely more on technology and its features, it becomes glaring that social studies teachers can no longer continue to teach the subject with the same old conventional method they have always done. They need to incorporate technology apps into their teaching and learning so as to be able to reach the minds and hearts of these young learners. It is against this backdrop that the authors intend to ascertain the perception of social studies on the use of social studies apps for enhancing students learning.

Aim and Objectives of the Study

Comment [KR4]: Very general discussion of the problems/issues. Need to provide more specific issues that affecting the use of social studies apps for teaching

Comment [KR5]: Suggest to simplify the objectives of the study. The terms used are too basic and general.

The aim of this study is to find out the awareness and attitude of social studies teachers on the use of social studies apps for enhancing students learning. Specifically, the study intends to:

1. Determine the awareness level of social studies teachers on the use of Social Studies apps.
2. Ascertain the awareness level of male and female social studies teachers on the use of Social Studies apps.
3. Find out the attitude of social studies teachers towards the use of Social Studies apps.
4. Find out the attitude of male and female social studies teachers towards the use of Social Studies apps.
5. Determine the relationship between social studies teachers' awareness of and attitude towards the use of Social Studies apps.
6. Identify the possible challenges that can hinder effective use of Social Studies apps by social studies teachers

Research Questions:

The following research questions guided this study:

1. What is the awareness level of social studies teachers on the use of Social Studies apps?
2. How does the awareness level of male and female social studies teachers differ on the use of Social Studies apps?
3. What is the attitude of social studies teachers towards the use of Social Studies apps?
4. How does the attitude of male and female social studies teachers towards the use of Social Studies apps differ?
5. What is the relationship between social studies teachers' awareness of and attitude towards the use of Social Studies apps.

6. How do male and female social studies teachers perceive the possible challenges that can hinder effective use of Social Studies apps?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the awareness level of male and female social studies teachers on the use of Social Studies apps.
2. The attitude of male and female social studies teachers towards the use of Social Studies apps do not differ significantly.
3. There is no significant relationship between social studies teachers' awareness of and attitude towards the use of Social Studies apps.

Methods

The scope of the study covered public secondary schools in Khana Local Government Area of Rivers State. The study was delimited to teachers in junior secondary schools (JSS 1-3) because these are the only levels where social studies is taught as a subject in public secondary schools in Rivers State. Variables considered included the awareness level and attitude of the social studies teachers, and their perception on the possible challenges they could face using social studies apps. The research design adopted for this study is descriptive survey. The population consists of fifty (50) Junior Secondary School Social Studies teachers in twenty-two (22) schools in Khana Local Government Area, which includes twenty (20) males and thirty (30) females. The sample size for this study was all the fifty (50) Junior Secondary School social studies teachers in the twenty-two (22) public schools in Khana Local Government Area. The sample was a census. This was deemed fit since the population size is small. The instrument used for data collection is a 52-item questionnaire titled: "Teachers' Awareness, Attitude and Perception Toward the Use of Social Studies App" (TAAPSAQ). It contained two parts: A and B. Part A covered demographic data of respondents such as School and sex; while part B had three (3) sections. Section A measured the Awareness level of respondents. It was measured on a four-point Likert Scale of Very Much Aware, Aware, Not Very Aware and Not at all Aware. Section B measured teacher's attitude towards social studies apps. It was also graded on a four-point Likert scale of Strongly Agree, Agree, Disagree and Strongly disagree. Finally, Section C covered the perceived challenges of

Comment [KR6]: Please reconstruct the hypothesis. Hypothesis should be aligned with objective and research questions.

Comment [KR7]: Satisfactory understanding of the significance of the research and a reasonably effective interpretation and application of the methodology. Arguments presented have minor flaws. There is some weakness in interpretation. Demonstrates an above average ability to articulate a critical response and an above average analysis of material.

teachers on the use of social studies apps. Respondents were required to choose an option of either Very Much a challenge, Much of a Challenge, Not Much of a Challenge, Not at all a Challenge.

The face and content validity of the TAAPSAQ was determined by experts from measurement and evaluation, social studies and educational technology. All experts were given copies of the instrument and their input, corrections and recommendations were incorporated in the final version of the instrument. The reliability of the TAAPSAQ was estimated using the Cronbach Alpha method of internal consistency. The whole instrument and its subscales were pilot tested on a sample of 20 respondents chosen outside the study sample. Every item in the instrument was analysed for quality and selection. The reliability of the Instrument as a whole was .837, the Social studies app awareness (SSA) subscale had a coefficient of 0.905, Attitude towards social studies apps subscale (ATSA) had a coefficient of .809 and Perceived Challenges of the use of social studies Apps (PCSA) had a coefficient of .842. The Cronbach Alpha coefficients above show that the instrument had good psychometric properties of validity and reliability. Mean and standard deviation were used to answer the research questions while independent sample t-test was used to analyse hypotheses 1 and 2, and Pearson Product Moment correlation (PPMC) was used to analyse hypothesis 3.

Results and Discussion

Research Question 1: What is the awareness level of social studies teachers on the use of Social Studies App?

Table 1: Mean and standard deviation analysis on the awareness level of social studies teachers on the use of Social Studies App

Variable	N	Mini stat	Max. Sta	Mean	Std. Error	Std. Dev
Soc. Studies App Awareness.	50	18.00	39.00	28.98	.7695	5.441

Comment [KR8]: Demonstrates adequate levels of understanding and originality in the analysis of the research findings. There is limited evidence of personal insights into the field. The research findings make a minor contribution to the knowledge base of the discipline and field of study. Some analytical treatment, but may be prone to description.

Table 1 shows the mean score of 28.98 and standard deviation of 5.441. This indicates that social studies teachers are Not Very Aware of the use of Social Studies App (awareness of social studies app, availability for use in teaching social studies, how to download the app, how to access image and visuals on the app, navigating the app, use of the app in communicating with learners and other teachers, app's limitation, varieties and categories) This is hinged on the premises that the criterion mean point of 1- 16.00 indicates *Not at all Aware*, a mean point of 17- 32.00 indicates *Not very Aware*, mean point of 33- 48.00 indicates *Aware* while a mean point of 49- 64.00 indicates *Very Much Aware*. And as seen from the table above the mean of 28.98 indicates or shows that social studies teachers are not very aware of the use of Social studies App

Research question 2: How does the awareness level of male and female social studies teachers differ on the use of Social Studies App?

Table 2: Mean & standard deviation analysis of the difference on the awareness level of male and female social studies teachers on the use of Social Studies App

Gender	N	Mean	Std. D	Std. Error
Male	20	30.000	5.428	1.213
Female	30	28.300	5.433	.9921

Table 2 shows a mean of 30.000 for the males and SD of 5.428 while the females had a mean of 28.300 and SD of 5.433. This indicates that there is a difference in the awareness level of male and female social studies teachers on the use of Social Studies App. As can be seen from the table 2, the mean of male teachers is higher than that of the females indicating that the male social studies teachers had a higher awareness level on the use of Social studies App. However, when subjected to statistical analysis, the results showed that the difference in their awareness level was not statistically significant (see Table 3)

Hypothesis 1: There is no significant difference in the awareness level of male and female social studies teachers on the use of Social Studies App

Table 3 Independent samples t-test analysis showing no difference in the awareness level of male and female social studies teachers on the use of Social Studies App

Gender	N	\bar{x}	SD	Df	T	Sig.	P	Decision
Male	20	30.00	5.42	48	1.084	.284	0.05	Accept Ho ₁
Female	30	28.30	5.43					P>0.05

The table 3 shows that $t(48) = 1.084$ $p > 0.5$, i.e $p = .284$ is greater than 0.05 therefore, the null hypotheses of no significant difference in the awareness level of male and female social studies teachers on the use of Social Studies App is accepted and the alternate rejected. This means that the awareness level of male and female social studies teachers on the use of Social Studies App is not significantly different

Research question 3: What is the attitude of social studies teachers towards the use of Social Studies App?

Table 4: Mean & standard deviation analysis of the attitude of social studies teachers' towards the use of Social Studies App

Variable	N	Mini stat	Max. Sta	Mean	Std. Error	Std. Dev
Soc. Studies App Attitude	50	16.00	66.00	46.34	1.3787	9.749

Table 4 shows the mean score of 46.34 and standard deviation of 9.74. This indicates that the attitude of social studies teachers towards the use of social studies App is positive. This is anchored on the premises that the criterion mean point of 44.00 and above indicates a positive attitude while below 39.99 indicates a negative attitude. As can be deduced from table 4, the mean of 46.34 is higher than the criterion mean of 44.00 thus showing a positive attitude of social studies teachers towards the use of social studies App.

Research question 4: How does the attitude of male and female social studies teachers differ on the use of Social Studies App?

Table 5 Mean & standard deviation analysis of the difference in the attitude of male and female social studies teachers on the use of Social Studies App

Gender	N	Mean	Std. D	Std. Error
Male	20	48.35	11.032	2.466

Female	30	45.00	8.729	1.593
---------------	----	-------	-------	-------

Table 5 shows a mean of 48.35 for the males and SD of 11.03 while the females have a mean of 45.00 and SD of 8.729. This indicates that there is a difference in the attitude of male and female social studies teachers on the use of Social Studies App. As can be seen from Table 5, the mean of males is higher than that of the females, indicating that the male social studies teachers have a more positive attitude on the use of Social studies App than their female counterpart.

Table 6 Independent samples t-test analysis showing no difference in the attitude of male and female social studies teachers towards the use of Social Studies App

Gender	N	\bar{x}	SD	Df	T	Sig.	P	Decision
Male	20	48.35	11.0	48	1.196	.238	0.05	Accept H_{01}
Female	30	45.00	8.72					P>0.05

The table 6 shows that $t(48) = 1.196$ $p > 0.5$, i.e $p = .238$ is greater than 0.05 therefore, the null hypotheses of the attitude of male and female social studies teachers towards the use of Social Studies App do not differ significantly is accepted and the alternate rejected. This means that the attitude of male and female social studies teachers towards the use of Social Studies App is not significantly different

Research question 5: What is the relationship between social studies teacher's awareness on the use of Social Studies App and their attitude towards the use of Social Studies App?

Hypothesis 3: There is no significant relationship between social studies teacher's awareness on the use of Social Studies App and their attitude towards the use of Social Studies App

Table 7; Showing the correlational relationship between social studies teacher's awareness on the use of Social Studies App and their attitude towards the use of Social Studies App

Variables	N	\bar{x}	SD	Df	R	Sig.	P	Decision
So.St Aw	50	28.98	5.44	48	.275	.053	0.05	Accept H_{01}
So.StAtt		46.34	9.74					P>0.05

The table 7 reveals a mean score of 28.98 and standard deviation of 5.441 indicating the awareness level of social studies teachers on the use of Social Studies App and a mean score of 46.34 and standard deviation of 9.74 indicating the attitude of social studies teachers towards the use of social studies app. Very significantly, the table further shows that when the variable of Social Studies teacher awareness of the use of social studies App was correlated with Social Studies teacher attitude towards the use of social studies App a $r(48) = .275$ was obtained. This reveals that there is a positive relationship between the two variables. However, the relationship is a low positive relationship. This implies that an increase in Social Studies teachers' awareness of the use of social studies App would lead to a low increase in Social Studies teachers' attitude towards the use of social studies App as both are related.

When the null hypothesis of there is no significant relationship between social studies teacher's awareness on the use of Social Studies App and their attitude towards the use of Social Studies App was tested, table 7 further shows that shows that $r(48) = .275$, $p > 0.5$, i.e $p = .053$ is greater than 0.05

Therefore, the null hypothesis of there is no significant relationship between social studies teacher's awareness on the use of Social Studies App and their attitude towards the use of Social Studies App was accepted and the alternate rejected. This means that the relationship that exists between social studies teacher's awareness on the use of Social Studies App and their attitude towards the use of Social Studies App is not significant statistically.

Research Question 6: How do male and female perceive the possible challenges that can hinder effective use of Social Studies App?

Table 8; Response and percentage score of how males and females perceive the possible challenges that can hinder effective use of Social Studies App

How Challenges are Perceived	Gender	N	Response	% of Total Response	of Total Response	% of Total Response

Very Much a Challenge	Male	20	32	5%	82	12%
	Female	30	50	7%		
Much a Challenge	Male	20	70	9%	173	23%
	Female	30	103	14%		
Not Much of a Challenge	Male	20	112	15%	278	38%
	Female	30	166	23%		
Not at all a Challenge	Male	20	77	11%	192	27%
	Female	30	115	16%		



Figure 1: Perception of male and female social studies on challenges that hinder the effective use of social studies app.

The table 8 and figure 1 shows how male and female social studies teachers perceive the possible challenges that can hinder effective use of Social Studies App. It reveals that the possible problems are perceived as *Not very much a challenge* as seen from the scores and percentages of the male and females and the total as well which was the highest. This implies that the possible perceived challenges which includes lack of internet facilities, limited knowledge on how to use social studies app, limited knowledge on how to integrate social studies app into teaching, lack of technical support, unsteady power supply to power computers and phone, limited time allocated for teaching, lack of technical know-how, negative attitude of students toward the use of the app, work overload, lack of gadgets for teaching, too much time required to download app, poor internet service, simplicity of social studies subject and negative attitude from teachers are perceived as *Not very much a challenge* by male and female social studies teachers,

Conclusion

From the foregoing, it is quite clear that the social studies teachers in Khana Local Government Area are not aware of social studies but possess a positive attitude towards utilizing the app. In addition challenges such as lack of internet facilities, limited knowledge on how to use social studies app, limited knowledge on how to integrate social studies app into teaching, lack of technical support, unsteady power supply to power computers and phone, limited time allocated for teaching, lack of technical know-how, negative attitude of students toward the use of the app, work overload, lack of gadgets for teaching, too much time required to download app, poor internet service, just to mention few are not perceived as very much a challenge for the social studies teachers. Thus, they are eager to overcome these challenges in order to use these apps. This buttresses the fact that the social studies teachers have a positive attitude toward the use of social studies app. Developing themselves professionally by undergoing training on the integration of ICT in teaching and learning with specific reference to utilization of social studies apps will go a long way to help these teachers expand their knowledge and be better equipped to impart knowledge, skills and attitude to learners who they teach. This will contribute to positive development in the community and the State at large.

Recommendations

Comment [KR9]: Discussion is sufficient with few errors. Conclusions are based on a detailed examination of outcomes and appropriate for study. The conclusions are partially logical and/or valid. They are communicated clearly. The final summary only partially communicates the purpose and findings of the study.

Based on the findings, the following recommendations were made:

1. The Rivers State Government should organize a seminar to create awareness of social studies apps among teachers and students in Khana Local Governemnt Area.
2. The government should also plan workshops that will enable teachers have hands-on experience oh how to use these apps and integrate them into their teaching
3. Social Studies teachers should take online courses that would expose them to the use of these apps.
4. Social studies teachers should develop positive attitude towards the use of social studies apps.

References

- Birabil, S.T. & Nwankwo, N.B. (2020). Social Studies Education: A linchpin for sustainable national development in Nigeria. *European Journal of Education Studies*. 7(1), 338-343.
- Common sense media (n.d) Social Studies Apps, Games, and Websites. Retrieved 7th February 2023 from <https://www.common sense media.org/lists/social-studies-apps-games-and-websites>
- EdTechReview (2014) 7 Great Social Studies apps for teachers and students. Retrieved 7th February, 2023 from <https://www.edtechreview.in/news/great-social-studies-apps-for-teachers-and-students/>
- Fomsi, E.F. & Anikpo, F.(2019) 21st Century Teaching for Digital Natives and Millenials: The attitude of classroom teachers. *National Journal of Advanced Research*. (5)(1) 64-68
- Hong, J., E. (2016). Social Studies Teachers' views of ICT integration. *RIGEO*, 6 (1), 32-48. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1158113.pdf>
- Huang, B. & Hew K. F (2015) Do points, badges and leaderboard increase learning and activity: A quasi-experiment on the effects of gamification. *Computers and Education*, 275-280.
- Mezieobi, Fubara and Mezieobi, (2008). Social studies in Nigeria: Teaching methods, instructional materials and resources. Owerri: Acadapeak. Publishers.
- Ogochukwu and Fomsi (2019) Gamification - Influence on elementary pupils' learning outcomes and engagement in English Language. *International Journal of English Language Teaching*(7) (2) 50-62

Comment [KR10]: The referencing has been done in a proper manner but There are, however, a number of inconsistencies. Please check again.

Siemens, G. (2005) Connectivism: A learning theory for the digital age. Retrieved 7th February, 2023 from https://www.itdl.org/Journal/Jan_05/article01.htm

Zakana, M.E. &Fomsi, E.F. (2019) Effect of Social Networking Sites on Students' Engagement and Motivation in Computer Science in Bayelsa State, Nigeria. *European Scientific Journal* (15) (5) ISSN: 1857 – 7881 (Print) e - ISSN 1857-7431. 132

UNDER PEER REVIEW