Relationship between Senior Secondary Schools Students' Metacognitive Attitude and their Academic Performance in Physics

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Abstract- Metacognitive has been acknowledged that it has significant role on students' academic performance in science. The concern of the present study is which aspect of metacognition has significant influence on students' academic performance. Therefore this study correlated some aspects of metacognition with senior secondary school students' academic performance in Physics. The study adopted survey method with the sample of 165 students from public secondary schools in Ilorin south, Kwara state in which 81 were male and 84 were female. Metacognitive Awareness Questionnaire (MAQ) and Students' Performance Request Form (SPRF) were used to collect data. The data were analyzed using descriptive statistic and Spearman Correlation Test. The result of findings revealed that students' participant exhibited metacognitive attitude and they perform averagely in Physics. The correlation shows that there is positive significant relationship between students' metacognitve attitude and their academic performance in Physics but some aspects of metacognition show no significant relation. It is therefore recommended that teachers should understand the aspects of metacognition need to exploit in students to enable them perform academically..

Index Terms— Academic performance,Metacognitive attitude, Physics.

1 Introduction

The concept of metacognition was originated from cognitive theory. It emerged as a specific focus of research in the early 1970s, with John Flavell who happens to be the pioneer and contributed immensely to the great amount of work in the area. It refers to higher order mental processes involved in learning such as making plans for learning, using appropriate skills and strategies to solve a problem, making estimates of performance and calibrating the extent of learning (Siddiqui & Dubey, 2018). Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature (Jain, Tiwari & Awasthi, 2017). Thus, metacognition is the mirror that give back the reflection of what students have learnt and how they learnt. The common components of metacognition are metacognitive knowledge and metacognitive regulation.

Herlanti and Soekisno (2018) defined metacognitive knowledge as an awareness of and knowledge about one's own cognition or the emphasis on helping students become more knowledgeable of and responsible for their own cognition and thinking. They further stressed that metacognitive awareness lead to the development of stronger cognitive skills and deeper information processing. Siddiqui and Dubey (2018) defined metacognitive regulation as those mechanisms that help to regulate one's thinking or learning. They also sub-divided metacognitive knowledge and metacognitive regulation as follow:

Metacognitive knowledge

- Declarative knowledge: This includes knowledge about oneself and others as a learner and about what factors influence one's performance.
- Procedural knowledge: This refers to knowledge of processes and actions and knowledge about the execution of procedural skills.
- Conditional knowledge: Refers to knowing when and why to apply various cognitive actions.

Metacogntive regulation

- Planning: It involves the selection of appropriate strategies and the allocation of resources that affect performance.
- Monitoring: It refers to one's on-line awareness of comprehension and task performance.
- Evaluation: Refers to appraising the products and a regulatory process of one's learning.

The main concern of research in education is to solve the educational problem, increase teachers' effectiveness and students' academic achievement. Recently, metacognition and its related processes have been shown to affect the human performance, functions and behaviours of the individuals in an array of situations including performance in educational setting (Jain, Tiwari & Awasthi, 2017). This resources are closely related to problem solving approach because anyone who can perform a metacognitive skill is thinking about how the skills are been performed. Metacognition enable the learners to detect their weakness in learning and determine the better way to learn. And today one of the main goals of education is to make the students gain the thinking skills and strategies which they will use throughout their lives, rather than storing information (Amutha & Sudha, 2016).

Considering Physics as a science subject perceived that it hard to understand, the common approach in teaching the subject is problem solving. If students know their learning, monitor their learning process, use appropriate learning strategies in order to cope with difficulties and self assessment; this will facilitate meaningful and permanent learning (Koc & Kuvac, 2016). Metacognition serve as mirror on the knowledge and thoughts of a learner in a way and indicate that reflection can either come from the inside of individual as well as other people. It seems plausible to assert that metacognitively aware learners are both intrinsically and extrinsically motivated (Öz, 2016). For this reason, student with metacognitive attitude should be actually motivated and has better academic performance. The study of Zobar and Barzilai (2013) found that there is relatively small number of studies that took place with young children and which especially cater for what metacognitive components are suitable for science instruction to young children in various developmental stages. Hence, this study tries to correlate students' metacognitive attitude with their academic performance to see if metacognitive attitude of the students influence their academic performance and which aspect of metacognition actually influence students academic performance.

To guide the study the following research questions were raised and answered, research hypotheses are formulated and tested:

Research Question

1. Do students in senior secondary school have metacognitive attitude in learning process?
2. Is gender determining students' metacognitive attitude in senior secondary school?
3. What is the performance of senior secondary school students in Physics?
4. What is the performance of senior secondary school students in Physics based on gender?

Research Hypotheses

HO_1: There is no significant relationship between students' metacognitive attitude and their academic performance in Physics.

HO_2: There is no significant relationship between students' metacognitive attitude and their academic performance in Physics based on gender.

2 Methodology

The survey research design was used in this study. A survey was conducted in senior secondary schools in Ilorin South, Kwara state, Nigeria. Senior Secondary School three (SSS3) science students were considered in the study. They are within the age range of 16 – 18 years. These students were considered for this study because they are almost adult; they are the students preparing for the external exam. For these reason, they should have reasoning ability to determine their metacognitive attitude during learning processes. This becomes a foundation in the questionnaire filled honestly by the students, which also shows the real condition. 165 students were randomly selected from science classes, 81 students were

male and 84 students were female.

There are two instruments used in the study, they are Metacognitive Awareness Questionnaire (MAQ) and Students' Performance Request Form (SPRF). MAQ is used to explore students' metacognitive attitude in learning process. The instrument has two session i.e. section A and section B. Section A consist bio-data of the students and section B consist the contents of metacognition which students responded to, and measured attitude with disagree-agree rating scale. The contents of the instrument are adapted from Herlanti and Soekisno (2018) and group into six aspect of metacognition such as declarative knowledge, procedural knowledge, planning, information management strategies, comprehension monitoring and evaluation. The contents are validated by Psychology expert and expert in science education in Federal University Gusau Zamfara. Then, further validation was done by administered the instrument to 38 students which are not among the students participated in the study but in the same local government, the result of alpha Cronbach score was 0.866. SPRF is used to collect the scores of students in Physics mock examination. Mock is a well organized examination in school to prepare students for the external examination (i.e. WACSSE and NECO). Most time questions are extracted from those external exam bodies. Hence, it has already validated and reliable.

The data is analyzed by descriptive statistic to find mean of students' response in order to answer research questions raised in the study. Spearman Correlation Test is used to analyze the relationship between metacognitive attitude of students and their performance in Physics. This is to test the hypotheses formulated in the study and all the hypotheses are tested at 0.05 level of significant.

3 Result of Findings

The analyses were based on the metacognitive attitude of the students in learning process and their academic performance in Physics. Six aspect of metacognition were put into consideration such as declarative knowledge, procedural knowledge, planning, information management strategies, comprehension monitoring and evaluation. These were also analysis based on gender. The result in table 1 shows that weighted response (WR) for each items as well as average weighted response (AWR) for each aspect of metacognition considered in the study is greater than 2.50 which is decision making level. This is an indication that students participant in the study have metacognitive attitude in the learning process.

The summary of AWR with respect to aspect of metacognition is shown in figure 1. That is, AWR of declarative knowledge, procedural knowledge, planning, information management strategies, comprehension monitoring and evaluation are 3.08, 3.05, 2.93, 2.91, 2.96 and 3.19 respectively and the AWR of the overall metacognitive attitude of students participant is 3.02.

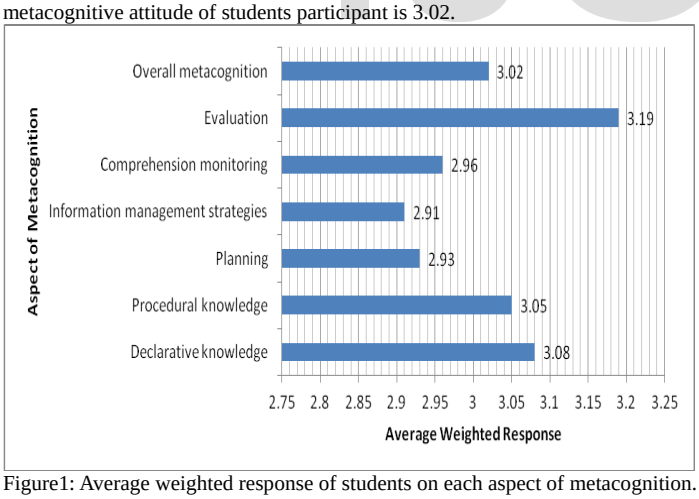

Figure1: Average weighted response of students on each aspect of metacognition.

Table 1: Metacognitive attitude of students

S/N	Aspect of Metacognition/ Questions	Students' Response						WR	AWR
		SA	A	UD	D	SD	Total		
	Declarative knowledge								
1	I am good in remembering formula for calculation in Physics.	33	123	9	0	0	165	3.04	3.08
2	I am good at organizing information in Physics calculation.	48	96	12	9	0	165	3.02	
3	I always judge myself how well I understand the content taught in Physics.	72	87	0	0	6	165	3.36	
4	I always disturb whenever I did not understand anything in Physics.	60	63	9	15	18	165	2.89	
	Procedural knowledge								
5	I find myself using helpful methods to solve Physics problems automatically.	42	105	9	6	3	165	3.02	3.05
6	I usually find alternative methods to solve Physics problems.	63	78	9	9	6	165	3.09	
	Planning								
7	I usually study Physics topics myself before learning it in class.	45	81	21	15	3	165	2.76	2.93
8	I ask myself questions about the topic before learning.	48	102	9	6	0	165	3.09	
	Information management strategies								
9	I create my own examples to make information more meaningful.	72	75	6	9	3	165	3.24	2.91
10	I draw picture or diagram to help me understand while learning.	36	69	21	24	15	165	2.51	
11	I use the organizational structure of the textbook to help me learn.	69	57	15	18	6	165	2.96	
12	I usually create a code to organize information in learning Physics.	63	57	12	24	9	165	2.91	
	Comprehension monitoring								
13	I find myself pausing regularly to check my comprehension in Physics.	51	90	15	6	3	165	2.96	2.96
	Evaluation								

14	I summarized what I learnt after learning in Physics.	48	105	9	0	3	165	3.09	3.19
15	I usually try to answer questions in Physics textbooks after learning.	69	84	3	6	3	165	3.29	
	Overall of Metacognition								**3.02**

Note: SA=Strongly agree; A=Agree; UD=Un disagree; D=Disagree; SD=Strongly disagree; WR=Weighted response; AWR=Average weighted response. Decision making = 2.50

Table 2 shows the result of metacognitive attitude of male students. It was observed that in all items, WR and AWR for all the aspect of metacognition is greater than 2.50. Figure 2 also give the summary of AWR of each aspect of metacognition and the overall of metacognitive attitude of male students. AWR of metacognitive attitude of male students on declarative knowledge, procedural knowledge, planning, information management strategies, comprehension monitoring and evaluation are 3.03, 3.07, 2.98, 2.97, 2.95, 3.20 respectively. Also, AWR of overall metacognition is 3.03, this shows that male students participated in the study have metacognitive attitude in the learning process.

Table 2: Metacognitive attitude of male students

S/N	Aspect of Metacognition/ Questions	Students' Response						WR	AWR
		SA	A	UD	D	SD	Total		
	Declarative knowledge								
1	I am good in remembering formula for calculation in Physics.	15	60	6	0	0	81	2.96	3.03
2	I am good at organizing information in Physics calculation.	21	51	6	3	0	81	3.00	
3	I always judge myself how well I understand the content taught in Physics.	39	36	0	0	6	81	3.33	
4	I always disturb whenever I did not understand anything in Physics.	27	33	6	6	9	81	2.82	
	Procedural knowledge								
5	I find myself using helpful methods to solve Physics problems automatically.	20	53	4	3	1	81	3.04	3.07
6	I usually find alternative methods to solve Physics problems.	31	39	4	4	3	81	3.11	
	Planning								
7	I usually study Physics topics myself before learning it in class.	23						.83	98
8	I ask myself questions about the topic before learning.	23	52	3	3	0	81	3.14	
	Information management strategies								
9	I create my own examples to make information more meaningful.	33	37	4	5	2	81	3.15	2.97
10	I draw picture or diagram to help me understand while learning.	18	37	8	11	7	81	2.62	
11	I use the organizational structure of the textbook to help me learn.	38	27	6	8	2	81	3.10	
12	I usually create a code to organize information in learning Physics.	31	30	4	13	3	81	3.00	
	Comprehension monitoring								
13	I find myself pausing regularly to check my comprehension in Physics.	25	44	8	3	1	81	2.95	2.95
	Evaluation								
14	I summarized what I learnt after learning in Physics.	25	49	6	0	1	81	3.06	3.20
15	I usually try to answer questions in Physics textbooks after learning.	34	43	1	2	1	81	3.33	
	Overall of Metacognition								**3.03**

Note: SA=Strongly agree; A=Agree; UD=Un disagree; D=Disagree; SD=Strongly disagree; WR=Weighted response; AWR=Average weighted response. Decision making = 2.50

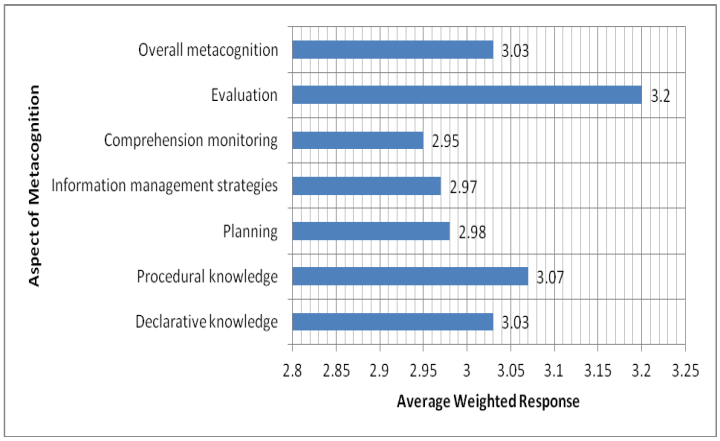

Figure2: Average weighted response of male students on each aspect of metacognition.

The result of female students' metacognitive attitude is shown in table 3. The result shows that except item 10, WR of other items is greater than 2.50. AWR of female metacognitive attitude on declarative knowledge, procedural knowledge, planning, information management strategies, comprehension monitoring and evaluation are 3.13, 3.04, 2.88, 2.85, 2.98 and 3.19 respectively. AWR of overall metacognion was also observed to be 3.00, this is an indication that female students participated in the study have metacognitive attitude since AWR is greater than 2.50 which is a decision making level. Figure 3 also give the summary of AWR on each aspect of metacognition and overall metacognition.

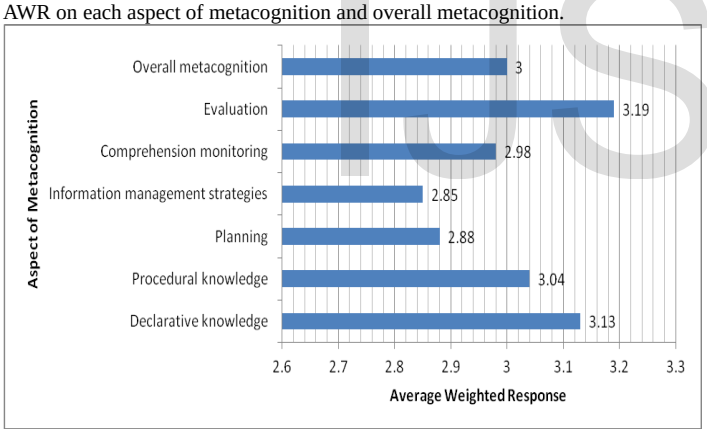

Figure3: Average weighted response of female students on each aspect of metacognition.

Table 3: Metacognitive attitude of female students

S/N	Aspect of Metacognition/ Questions	Students' Response						WR	AWR
		SA	A	UD	D	SD	Total		
	Declarative knowledge								
1	I am good in remembering formula for calculation in Physics.	18	63	3	0	0	84	3.11	3.13
2	I am good at organizing information in Physics calculation.	27	45	6	6	0	84	3.04	
3	I always judge myself how well I understand the content taught in Physics.	33	51	0	0	0	84	3.39	
4	I always disturb whenever I did not understand anything in Physics.	33	30	3	9	9	84	2.96	
	Procedural knowledge								
5	I find myself using helpful methods to solve Physics problems automatically.	22	52	5	3	2	84	3.00	3.04
6	I usually find alternative methods to solve Physics problems.	32	39	5	5	3	84	3.07	
	Planning								
7	I usually study Physics topics myself before learning it in class.	23	40	13	7	1	84	2.70	2.88
8	I ask myself questions about the topic before learning.	25	50	6	3	0	84	3.05	
	Information management strategies								
9	I create my own examples to make information more meaningful.	39	38	2	4	1	84	3.32	2.85
10	I draw picture or diagram to help me understand while learning.	18	32	13	13	8	84	2.41	
11	I use the organizational structure of the textbook to help me learn.	31	30	9	10	4	84	2.83	
12	I usually create a code to organize information in learning Physics.	32	27	8	11	6	84	2.82	
	Comprehension monitoring								
13	I find myself pausing regularly to check my comprehension in Physics.	26	46	7	3	2	84	2.9	2.98

								8	
	Evaluation								
14	I summarized what I learnt after learning in Physics.	23	56	3	0	2	84	3.12	3.19
15	I usually try to answer questions in Physics textbooks after learning.	35	41	2	4	2	84	3.25	
	Overall of Metacognition								**3.00**

Note: SA=Strongly agree; A=Agree; UD=Un disagree; D=Disagree; SD=Strongly disagree; WR=Weighted response; AWR=Average weighted response. Decision making = 2.50

The performance of students participated in Physics is shown in table 4. This shows that 81 male students and 84 female students are participated in the study and the mean score showing the performance of male and female students are 54.53 and 53.27 respectively. Both male and female students perform averagely in Physics. The mean score for all students participated (i.e. both male and female) is 53.89. This is an indication that there is an average performance in Physics for students participated in the study.

Table 4: Students mean score in Physics

GENDER	NUMBER OF STUDENTS	MEAN SCORE(%)
MALE	81	54.53
FEMALE	84	53.27
TOTAL	**165**	**53.89**

The result in table 5 shows relationship between metacognitive attitudes of students based on each aspect of metacognition considered in the study and students' academic performance in Physics. This was done on gender wise and overall students. The correlation between declarative knowledge and students' performance shows that there is negative and no significant relationship for male students as (r = -0.042, P>0.05) while positive and no significant relationship exhibited by female students as (r = 0.070, P>0.05) and for all students there is negative and no significant relationship as (r = -0.006, P>0.05). The correlation between procedural knowledge and students' performance revealed that male students exhibit no significant relationship as (r = 0.165, P>0.05) and significant relationship exhibit by female and overall students as (r = 0.298, P<0.05) and (r = 0.232, P<0.05) respectively. There is no significant relationship when planning, information management strategies and comprehension monitoring are correlated with students' academic performance as in planning: Male(r = 0.076, P>0.05), Female(r = 0.025, P>0.05) and Overall students(r = 0.050, P>0.05); information management strategies: Male(r = 0.129, P>0.05), Female(r = 0.059, P>0.05) and Overall students(r = 0.095, P>0.05); and comprehension monitoring: Male(r = 0.115, P>0.05), Female(0.115, P>0.05 and Overall students(r = 0.114, P>0.05). Significant relationship existed when evaluation as an aspect of metacognition correlated with students' academic performance as Male(r = 0.311, P<0.05), Female(r = 0.259, P<0.05) and Overall students(r = 0.283, P<0.05). Lastly, overall metacogniyion was correlated with students' academic performance. The result revealed that male students exhibit no significant relationship as (r = 0.170, P>0.05) and there is significant relationship by female and overall students as (r = 0.240, P<0.05) and (r = 0.202, P<0.05) respectively.

Table 5: Correlation between students' metacognitive attitude and their academic performance in Physics

MEASURES	GENDER	R	P	DECISION
DECLARATIVE KNOWLEDGE & STUDENTS' PERFORMANCE	MALE	-0.042	0.709	NS
	FEMALE	0.070	0.528	NS
	OVER-ALL	-0.006	0.942	NS
PROCEDURAL KNOWLEDGE & STUDENTS' PERFORMANCE	MALE	0.165	0.142	NS
	FEMALE	0.298	0.006	S
	OVER-ALL	0.232	0.003	S
PLANNING & STUDENTS' PERFORMANCE	MALE	0.076	0.498	NS
	FEMALE	0.025	0.820	NS
	OVER-ALL	0.050	0.521	NS
INFORMATION MANAGEMENT STRATEGIES & STUDENTS' PERFORMANCE	MALE	0.129	0.250	NS
	FEMALE	0.059	0.597	NS
	OVER-ALL	0.095	0.227	NS
COMPREHENSION MONITORING & STUDENTS' PERFORMANCE	MALE	0.115	0.308	NS
	FEMALE	0.115	0.300	NS
	OVER-ALL	0.114	0.145	NS
EVALUATION & STUDENTS' PERFORMANCE	MALE	0.311	0.005	S
	FEMALE	0.259	0.018	S
	OVER-ALL	0.283	0.000	S
OVERALL OF METACOGNITIVE & STUDENTS' PERFORMANCE	MALE	0.170	0.130	NS
	FEMALE	0.240	0.028	S
	OVER-ALL	0.202	0.009	S

Note: NS = Not significant; S = Significant

4 Discussion

The study first stand to find out the metacognitive attitude of students in senior secondary school, it evinced that students possess metacognitive attitude in learning process. The result of the study overlaps with the result of Herlanti and Soekisno (2018) and Koc and Kuvac (2016). The study of Herlanti and Soekisno (2018) found out the metacognitive attitude of teachers and students in science class and it revealed that both have good metacognitive attitude. The study of Koc and Kuvac (2016) also revealed that metacognitive awareness levels of preservice science teachers were generally found high. Though this study did not find the different in metacognitive attitude of male and female students, but it shows that both male and female students have metacognitive attitude in learning process. It was in one item of an aspect of metacognition (i.e. information management strategies) that female students did not possess (see table 3), this is in line with Herlanti and Soekisno (2018) which stated that many students rarely did in drawing pictures or diagrams to help them understand while learning. Secondly, the performance of students in Physics was presented. It is observed that both male and female are perform averagely. Their performances are not differ as well as their metacognitive attitude.

The study found positive and significant relationship between students' attitude of metacognition and their academic performance. This result is line with the study of Jain, Tiwari and Awasthi (2017) which established that positive aspects of metacogniton (declarative knowledge, procedural knowledge, conditional knowledge, planning, information management, monitoring, debugging, evaluation component of metacognition and overall metacognitive awareness) exhibited mostly significant correlations with the score of academic achievements. This gives insight about metacognition in learning process. Teacher need to find a way to explore students' metacognitive attitude since they already possess it in their learning process. Promoting metacognition begins with building an awareness among learners that metacognition exists, differs from cognition and increases academic success (Amutha & Sudha, 2016). Pre-service and in-service teachers need to be trained in such a way that promote their metacognitive knowledge and skill and teach metacognitively. Ozturk (2018) hypothesized that metacognition component teachers can teach students metacognition while they plan, monitor, regulate such instruction. The task of teachers is to acknowledge, cultivate, exploit and enhance the metacognitive capabilities of all learners (Siddiqui & Dubey, 2018). If this is consider in the learning process, it could be a critical ingredient to successful learning.

The uniqueness of this study is that the result established that not all the aspect of

metacognition has positive significant influence on students' academic performance. This is contrary to the result established by Jain, Tiwari and Awasthi (2017). Some aspect of metacognition such as declarative knowledge, planning, information management strategies comprehension monitoring has no significant relation with students' academic performance. Declarative knowledge has a negative relationship with students' academic performance. This means that some students have a good declarative knowledge about them self (i.e. they know what they don't understand and always disturb when they don't understand something) but in the absent of someone or teacher to guide them to the best strategies, their performance may remain the same without any improvement. Gender differences in the relationship between some of aspect of metacognition and students' academic performance are established. In declarative knowledge male students have negative relation while female students have positive relation. In procedural knowledge male students have no significant relation while female students have significant relation. In the overall of metacognition male students have no significant relation while female students have significant relation. This implies that male and female are differ in terms of how metacognitive attitude influence their academic performance.

5 Conclusion

The major conclusion of the study is that metacognitive attitude of the students have significant influence on students' academic performance. The study also provided that not all the aspect of metacognition could influence students' academic performance. It is now recommended that science teachers should understand the aspect of metacognition need to exploit in student for their performance academically.

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