

## **Pedagogical Content Knowledge (PCK) of Geography Teachers' and its Effect on Self-efficacy and Teacher Effectiveness in West Bengal, India**

**Anujit Patra<sup>1#</sup> & Abhijit Guha<sup>2</sup>**

<sup>1</sup>Research Scholar, Ramakrishna Mission Sikshanamandira (SVCMDRES), Belur Math, Howrah, West Bengal, India.

<sup>2</sup>Associate Professor, Ramakrishna Mission Sikshanamandira, Belur Math, Howrah, West Bengal, India.

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<sup>#</sup>Corresponding author.

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### ABSTRACT

*The present study is concerned with the subject of Geography and its teachers in secondary school. The objective was to find out the status of pedagogical content knowledge (PCK) in Geography teachers and also its effect on Self-efficacy and Teacher effectiveness together. For conducting this study descriptive survey method was employed. The data was collected from 401 Geography teachers of secondary schools of West Bengal. The data was analyzed through SPSS 21. The MANOVA result led to reject the null hypothesis at 0.05 level of significance that there would be no significant multivariate effect for the combined dependent variables of self-efficacy and teacher effectiveness in respect of teachers' level of PCK in geography with Wilks' Lambda (i.e. Exact Statistic) value of .970, Pillai's Trace value of .030, Hotelling's Trace value of .031 and Roy's Largest Root value of .031. All the 'p' values were less than .05. Post hoc test showed that teachers with high level of PCK in Geography were significantly different from the teachers having moderate and low levels of PCK in geography in their self-efficacy. On the other hand, teachers with high level of PCK were significantly different from the teachers having low levels of PCK in geography in teacher effectiveness. Study also revealed that, teachers self-efficacy is positively related with teacher effectiveness in geography teaching.*

**Keywords:** Pedagogical Content Knowledge, Self-efficacy, Teacher effectiveness, Geography teachers.

### 1. INTRODUCTION:

In the learner oriented modern teaching learning system, the teaching must facilitate learning and student can learn spontaneously. Teacher value is much important issue for shaping of student achievement. For this purpose, teacher has to play a vital role. He has to be equipped with his subject (content) knowledge and also to be competent enough to teach (pedagogy) his subject knowledge to the students. According to Shulman, pedagogical content knowledge (PCK) as a special amalgamation of content and pedagogy that is especially the area of teachers, their own special form of professional understanding. PCK is a characteristic of teacher knowledge of how to teach the subject matter. The term pedagogical content knowledge is widely discussed in teacher education program in West Bengal, India. PCK is an integrated knowledge of a specific content and how to teach it [20, 21]. If a teacher possesses good PCK in his subject it is expected that it will influence his belief in self with respect to his efficacy in teaching and his effectiveness in teaching [4]. PCK is defined as a construct that includes both teachers' understanding and enactment of those things that teachers do. The professional experience (execution of PCK) and individual features (efficacy) of teachers has played a significant result on the teaching learning process in the classroom. Self-efficacy beliefs and Pedagogy Content Knowledge (PCK) affect teaching qualification and sustainability of pre-service and in-service teachers, so that the bilateral interaction of self-efficacy and PCK needs to be studied in order to be a guide in regulating the process of education or training teachers [7].

Teacher efficacy can be defined as a teacher's knowledge of self in terms of his or her own capability in teaching for a particular subject. The effect of teacher efficacy on teaching performance is recognized on the grounds of the social cognitive theory [6]. Elementary science teachers' PCK positively predicts students' achievement [13]. The positive correlations between teacher pedagogical content knowledge and student achievement provide authentication that an effective teacher could create good results in the children of middle school [14]. The increase in the contents of pedagogical knowledge resulted in changed pedagogical approaches, enhanced teacher student interaction, refinement of appropriate learning outcomes, critical decision making, improved teacher confidence, and enhanced student learning [12]. Effective teachers produced better performing students but that, not the only determinant of students' academic achievement [2]. Found significant difference in PCK of mathematics teacher in relation to qualification and experience, like teachers having higher qualifications and teaching experience found having better PCK and classroom teaching [16].

Research has found relationship between teacher knowledge (PCK) and teacher effectiveness. Self-efficacy is a critical component of effective teaching and can increase student achievement, it considered as a promoter of a teacher's movement from understanding to action [10].

In-service teachers' efficacy levels can be confidently forced by increased in content-specific pedagogical emphasis [22]. Teachers' knowledge of subject matter, attitude to work and teaching skills has a significant relationship on students' academic performance [1]. Higher teacher efficacy is related to higher student achievement and motivation, higher teacher retention and professional commitment, and more willingness to try new innovations and technologies. Teacher's sense of self-efficacy has been consistently recognized as an important attribute of effective teaching and has been positively correlated to teacher and student outcomes [23]. Teachers' self-efficacy made a significant contribution to the prediction of students' motivation to learn subject [17].

Student did differ in achievement of subject due to high or low teaching effectiveness of teachers. Significant correlation has been established between teacher competency and teaching effectiveness which signifies that, teacher competency factors related to teaching effectiveness [5]. Teachers in the latter stages of their career had different beliefs about their ability to perform important teaching activities that help pupils to learn. Consequently, it appears that teachers with extensive experience are better prepared for day-to-day teaching practice [19].

Based on the literature review, researchers found that, there were different studies conducted separately for self-efficacy and teacher effectiveness in respect of teachers' pedagogical content knowledge in different subjects at the school level, but there has been little done in the subject geography. This paper aims to describe the combined effect of PCK on self-efficacy and teachers effectiveness in the geography teaching at Bengali medium schools of West Bengal, India.

## 2. HYPOTHESIS:

**Ho:** There will no significant multivariate effect for the combined dependent variables of self-efficacy and teacher effectiveness in respect of teachers' level of PCK in geography.

## 3. METHODOLOGY:

The study was conducted through descriptive survey. **Variables:** Major variables of the study were (i) Pedagogical Content Knowledge (PCK) (ii) Self- Efficacy (iii) Teacher effectiveness. **Population:** The geography teachers who engaged in secondary and higher secondary schools, affiliated by W.B.B.S.E. only considered as the population of the present study. **Sample:** 401 geography teachers were randomly selected from different districts of west Bengal. **Tools:** Present researchers had used three types of tools; one was self made and standardized PCK Measuring Tool (PCKMT) to measure the teachers' PCK towards teaching of geography subject in Bengali medium school. Second was Self-efficacy scale (SES) constructed and validated by Dr. Arun Kumar Singh and Dr. Shruti Narin, published by National Psychological Corporation, Agra, India. Third scale was Teacher Effectiveness Scale (TES) constructed and validated by Dr. (Mrs.) Umme Kulsum, which also published by National Psychological Corporation, Agra, India. **Procedure:** Quantitative data were analyzed through SPSS 21.0 and MANOVA was used to study the effect of PCK on self-efficacy and teacher effectiveness together.

## 4. RESULTS:

### 4.1. Preliminary Analysis:

At first the Multivariate output describes the factors involved in the analysis. Those are labeled between-subject factors (Table.1), this was appropriate because the High, Moderate and Low PCK group were studied in the sample. With the help of obtained raw scores through PCK measuring tool, Total sample (401) has been grouped in to three separate levels, i.e. Low (N=135), Moderate (N=162), High (N=104) on the basis of the equal percentile scores i.e. nearly 33.33 percent (%) shows in the table: 1. Table: 2 shows an initial description of the factor wise dependent variables. This table contains the overall and group means and standard deviations for each dependent variable (Self-efficacy i.e. 76.73 and Teacher effectiveness i.e. 447.77) in order. It was understandable from

the means that, the group with high PCK has the mean score on self-efficacy was 78.33. The group with moderate PCK has the mean score on self-efficacy is 76.58 and the group with low PCK has the mean score on self-efficacy was 75.69. On observation it was seen that, there were group wise mean differences in self-efficacy. As well as in respect of Teacher Effectiveness, the group with high PCK has the mean score on teacher effectiveness was 461.87. The group with moderate PCK has the mean score on teacher effectiveness was 447.89 and the group with low PCK has the mean score on teacher effectiveness was 436.76. On observation it was seen that, there were group wise mean differences in teacher effectiveness also.

#### **4.2. Assumptions Testing:**

**(i) Sample Size:** The size of sample was 401 school teachers, who were engaged to teach geography, randomly selected from Secondary schools from different Districts of West Bengal. Having of large sample always helps to away with violations of the other assumptions (e.g. Normality) [18]. In this study (Table: 2) Descriptive Statistics shows the data pattern with satisfied the assumption.

**(ii) Normality and Outliers:** Before using multivariate test researcher also tested the assumption concerning with the normality and outliers of data. Without these two assumptions test of MANOVA could not significant because MANOVA is much sensitive to outliers [18]. In this study Mahalonabis distance used to check the normality, which was also helpful to identify any outliers. Table 3; shows that, in the row labeled **Mahal. Distance** corresponding with the column marked **Maximum**, the obtained value was 13.009 which was less than the critical value 13.82 (Table 4). Therefore researchers have satisfied with the assumption that, there were no considerable multivariate outliers. Assumptions concerning to the multivariate normality also acceptable.

**(iii) Linearity:** This assumption refers to the existence of straight line relationship between each pair of dependent variables. In this study the researcher tried to find out the presence of straight line relationship between each pair of dependent variable. To check linearity, matrix of scatter plots (Fig. 1) used between each pair of variables, separately for PCK group (High, Moderate and Low). These plots did not show any evidence of non-linearity, so the assumption of linearity was satisfied.

**(iv) Multicollinearity:** MANOVA works best if the dependent variables were moderately correlated. It also sensitive with highly correlated dependent variables [18]. In this study the 'r' value between self-efficacy and teacher effectiveness was .247, which was less than .8 (strong relation). Therefore the assumption concerning with multicollinearity was satisfied.

**(v) Homogeneity of variance-covariance matrices:** Analysis (Table 6) Shows there was homogeneity of variance covariance matrices because the significance value p was 0.292 ( $p > .05$ ). That means the box's test indicated no significant difference across the groups and the assumption was tenable.

**(vi) Homogeneity of Variances:** Table 7; indicates that, there was homogeneity across groups variance of self-efficacy and teacher effectiveness of geography teachers, because in the Sig. column, for both the self-efficacy was .056 ( $p > .05$ ) and the teacher effectiveness was .767 ( $p > .05$ ), so researcher can say that, there was no violations the assumption of equality of error variance for both variables, i.e. Self-efficacy and Teacher Effectiveness.

#### **4.3 Multivariate Outcome:**

After satisfying the assumptions multivariate analyses can make a significant result, (Table 8.). The multivariate tests of significance will indicate whether there were statistically significant differences among the group of PCK (i.e. High, Moderate, Low) on a linear combination of dependent variables (i.e. Self-Efficacy and Teacher Effectiveness). There are a number of statistics to select from Wilks' Lambda, Hotelling's Trace, Pillai's Trace. One of the most frequently reported statistics is Wilkis' Lambda (Pallant, 2010, p. 294). It also used when the independent variable has more than two groups [15]. Here analysis (Table 8) shows Wilks' Lambda (i.e. Exact Statistic) value of .970, with a significance value of .015, Pillai's Trace value of .030 with a significance value of .016, Hotelling's

Trace value of .031 with a significance value of .015 and Roy's Largest Root value of .031 with a significance value of .002. All the 'p' values were less than .05; therefore it was concluded that, for the PCK factor (i.e. High, Moderate and Low), there were statistically significant differences in the combined dependent variables of self-efficacy and teacher effectiveness. Therefore, there was a significant multivariate effect for the combined dependent variables of self-efficacy and teacher effectiveness in respect of group of PCK (High, Moderate and Low).

#### **4.4: Univariate Outcome:**

From the above discussion it was clear that, the Geography teachers' PCK had a significant combined effect on their self-efficacy and effectiveness. The nature of that effect was not comprehensible from the multivariate test statistic [8]. This test tells not about which groups differed from which and nothing whether the effect of PCK was on self-efficacy, teacher effectiveness, or a combination of both. To determine the nature of the effect researchers used univariate tests.

In the table 9; the third set of values in a row labeled with PCK as independent value researcher found both the dependent variables listed, with their associated univariate F, df and Sig. values. It was found from the Sig column that, both the dependent variables self-efficacy ( $p = .012$ ) and teacher effectiveness ( $p = .043$ ) recorded with significant value ( $p < .05$ ). In this study significant difference were observed between High, Moderate and Low level of PCK group in teachers' self-efficacy as well as teacher effectiveness. Table 9; also shows that, both dependent variables ( Self-efficacy and Teacher effectiveness) differed significantly in respect of the independent variable (Groups\_PCK): Self-Efficacy;  $F(2, 398) = 4.491, p = .012$ ; Teacher Effectiveness;  $F = 3.163, p = .043$ .

**(i) Effect size:** The impact of PCK levels of teachers on their self-efficacy and teacher effectiveness evaluated using the effect size statistic provided in the column i.e. Partial Eta Squared [18], which represents the proportion of the variance in the dependent variables that can be explained by the independent variable (Group\_PCK). In this study for self-efficacy the value was 0.022, and for teacher effectiveness the value was .016, both were considered quite a small effect. This represents only 2.2 per cent of the variance in self-efficacy and 1.6 per cent of the variance in teacher effectiveness explained by PCK.

**(ii) Observed Power:** Here power means the probability of perfectly rejecting the null hypothesis. The power of the interaction effect was .766 for self-efficacy and .605 for teacher effectiveness. If the study were to be replicated 100 times it could correctly reject the null hypothesis on self-efficacy 76.6 % and on 60.5 % of those replications.

#### **4.5 Post Hoc Test:**

Follow-up univariate analyses was necessary due to the presence of three levels in the dependent variable (i.e. Group\_PCK) to recognize where the significance difference lie [18]. From the table 10; which contains multiple comparisons across the GROUP\_PCK with the help of most liberal, Fisher's LSD post hoc test. This suggested teachers had high level of PCK were significantly more self-efficacious than the teachers had moderate and low levels of PCK in geography. On the other hand teachers had high level of PCK were significantly more effective than only the teachers had low levels of PCK in geography.

### **5. FINDINGS AND DISCUSSIONS:**

A one-way between groups multivariate analysis of variance was performed to investigate impact of Pedagogical Content Knowledge (PCK) difference in geography teachers. Two dependent variables were used: self efficacy scores and teacher effectiveness scores. The independent variable was levels of PCK (i.e. High, Moderate, and Low) of geography teachers. Preliminary assumption testing was conducted to check for linearity, multivariate normality and outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. There was a statistically significance difference across the PCK groups (High, Moderate and Low) on the combined dependent variables,  $F(4, 794) = 3.096, p = .015 (p < .05)$ ; Wilks' Lambda = .970; partial eta squared = .015. When the results for the dependent variables were considered separately, both differences reached to statistical significance, using the alpha level .05, was self-efficacy,  $F(2, 398) = 4.491, p =$



.012 ( $p < .05$ ); partial eta squared = .022 and teacher effectiveness,  $F(2, 398) = 3.163$ ,  $p = .043$  ( $p < .05$ ); partial eta squared = .016. Values of the mean scores indicated that, teachers having high PCK slightly higher levels of self-efficacy than teachers having moderate and low PCK in geography. Similar result recorded by [3, 4, 11]. On the other hand the mean scores also indicated that, teachers having high PCK slightly higher levels of teacher effectiveness than teachers having low PCK in geography [4, 12, 13]. There was significant multivariate effect of PCK for the combined dependent variables of self-efficacy and teacher effectiveness of geography teachers. Study also found that, self-efficacy and teacher effectiveness are related to each other positively, which is supported by [4, 10, 23].

## 6. CONCLUSION:

The study is significant in that, it will help the geography teachers in understanding the function of PCK in their teaching process as a major factor. Through this study the teachers of geography will be able to realize the importance of PCK in developing self-efficacy and increasing their effectiveness. It is said that geography teachers' self-efficacy and effectiveness is closely related together. So they should be able to improve their students' academic achievements. The study might also be helpful to increase consciousness among different authorities who are engaged to train both pre-service and in-service programmes for geography teachers in West Bengal, India. The teacher educator also realizes the need to discuss PCK and its allied matters with more concentration to make trainees' more efficacious and effective.

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Tables & Figures

		Value Label	N	%
GROUP_PCK	1	LOW	135	33.66
	2	MODERATE	162	40.40
	3	HIGH	104	25.94
TOTAL			401	100

DEPENDENT VARIABLES	GROUP_PCK	Mean	Std. Deviation	N
SELF-EFFICACY	LOW	75.69	7.33	135
	MODERATE	76.58	6.81	162
	HIGH	78.33	6.01	104
	Total	76.73	6.86	401
TEACHER EFFECTIVENESS	LOW	436.76	77.82	135
	MODERATE	447.89	76.02	162
	HIGH	461.87	75.58	104
	Total	447.77	76.93	401

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.55	2.24	1.92	.132	401
Std. Predicted Value	-2.833	2.399	.000	1.000	401
Standard Error of Predicted Value	.038	.142	.063	.019	401
Adjusted Predicted Value	1.56	2.26	1.92	.132	401
Residual	-1.240	1.316	.000	.758	401
Std. Residual	-1.632	1.733	.000	.997	401
Stud. Residual	-1.646	1.747	.000	1.001	401
Deleted Residual	-1.261	1.338	.000	.763	401
Stud. Deleted Residual	-1.650	1.752	.000	1.002	401
<b>Mahal. Distance</b>	<b>.003</b>	<b>13.009</b>	<b>1.995</b>	<b>1.892</b>	<b>401</b>
Cook's Distance	.000	.024	.002	.003	401
Centered Leverage Value	.000	.033	.005	.005	401

a. Dependent Variable: GROUP\_PCK



Table: 4. Critical values for evaluating Mahalanobis distance values

Number of Dependent Variables	2	3	4	5	6	7	8	9	10
Critical Value	13.82	16.27	18.47	20.52	22.46	24.32	26.13	28.88	29.59

Source: adapted from a Table in Pallant,(2010). P-288; originally from Pearson, E.S. and Hartley, H.O.(Eds) (1958). Biometrika Tables for statisticians (vol. 1, 2<sup>nd</sup> edn). New York: Cambridge University Press.

Table: 5 Correlation Matrix between Self-Efficacy and Teacher Effectiveness

		SELF EFFICACY	TEACHER EFFECTIVENESS
SELF-EFFICACY	Pearson Correlation	1	.247*
	Sig. (2-tailed)		.000
	N	401	401
TEACHER EFFECTIVENESS	Pearson Correlation	.247*	1
	Sig. (2-tailed)	.000	
	N	401	401

\*Correlation is Significant at the 0.05 level (2-tailed).

Table: 6. Box's Test of Equality of Covariance Matrices<sup>a</sup>

Box's M	7.382
F	1.221
df1	6
df2	2029613.016
Sig.	.292

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.<sup>a</sup>

b. Design: Intercept + GROUP\_PCK

Table: 7. Levene's Test of Equality of Error Variances <sup>a</sup>				
Dependent Variable	F	df1	df2	Sig.
SELF EFFICACY	2.902	2	398	.056
TEACHER EFFECTIVENESS	.266	2	398	.767

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.<sup>a</sup>

b. Design: Intercept + GROUP\_PCK

Table: 8. Multivariate Tests <sup>a</sup>							
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.993	26876.977 <sup>b</sup>	2.000	397.000	.000	.993
	Wilks' Lambda	.007	26876.977 <sup>b</sup>	2.000	397.000	.000	.993
	Hotelling's Trace	135.400	26876.977 <sup>b</sup>	2.000	397.000	.000	.993
	Roy's Largest Root	135.400	26876.977 <sup>b</sup>	2.000	397.000	.000	.993
GROUP_PCK	Pillai's Trace	.030	3.081	4.000	796.000	.016	.015
	Wilks' Lambda	.970	3.096 <sup>b</sup>	4.000	794.000	.015	.015
	Hotelling's Trace	.031	3.112	4.000	792.000	.015	.015
	Roy's Largest Root	.031	6.212 <sup>c</sup>	2.000	398.000	.002	.030

a. Design: Intercept + GROUP\_PCK  
 b. Exact statistic  
 c. The statistic is an upper bound on F that yields a lower bound on the significance level.  
 d. Computed using alpha = .05

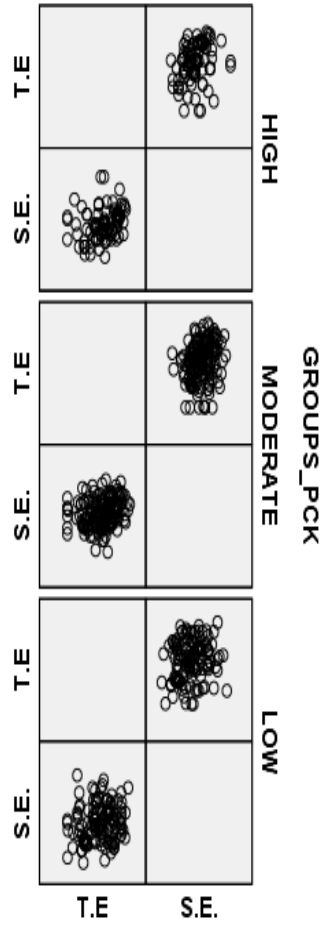
Table: 9. Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Corrected Model	SELF EFFICACY	415.174 <sup>a</sup>	2	207.587	4.491	.012	.022	.766 <sup>a</sup>
	TEACHER EFFECTIVENESS	37042.916 <sup>b</sup>	2	18521.458	3.163	.043	.016	.605 <sup>b</sup>
Intercept	SELF EFFICACY	2292437.794	1	2292437.794	49593.772	.000	.992	1.000
	TEACHER EFFECTIVENESS	78165094.039	1	78165094.039	13350.413	.000	.971	1.000
GROUP_PCK	SELF EFFICACY	415.174	2	207.587	4.491	.012	.022	.766
	TEACHER EFFECTIVENESS	37042.916	2	18521.458	3.163	.043	.016	.605
Error	SELF EFFICACY	18397.275	398	46.224				
	TEACHER EFFECTIVENESS	2330243.049	398	5854.882				
Total	SELF EFFICACY	2379892.000	401					
	TEACHER EFFECTIVENESS	82765388.000	401					
Corrected Total	SELF EFFICACY	18812.449	400					
	TEACHER EFFECTIVENESS	2367285.965	400					

a. R Squared = .022 (Adjusted R Squared = .017)  
 b. R Squared = .016 (Adjusted R Squared = .011)  
 c. Computed using alpha = .05

Table: 10. Multiple Comparisons					
Dependent Variable	(I) GROUP_ PEDAGOGICAL CONTENT KNOWLEDGE	(J) GROUP_ PEDAGOGICAL CONTENT KNOWLEDGE	Mean Difference (I-J)	Std. Error	Sig.
SELF-EFFICACY	<b>LOW</b>	MODERATE	-.8914	.79230	.261
		<b>HIGH</b>	<b>-2.6380*</b>	.88706	.003
	<b>MODERATE</b>	LOW	.8914	.79230	.261
		<b>HIGH</b>	<b>-1.7467*</b>	.85428	.042
	<b>HIGH</b>	<b>LOW</b>	<b>2.6380*</b>	.88706	.003
		<b>MODERATE</b>	<b>1.7467*</b>	.85428	.042
TEACHER EFFECTIVENESS	<b>LOW</b>	MODERATE	-11.1333	8.91688	.213
		<b>HIGH</b>	<b>-25.1098*</b>	9.98331	.012
	<b>MODERATE</b>	LOW	11.1333	8.91688	.213
		<b>HIGH</b>	-13.9765	9.61448	.147
	<b>HIGH</b>	<b>LOW</b>	<b>25.1098*</b>	9.98331	.012
		<b>MODERATE</b>	13.9765	9.61448	.147
Based on observed means. The error term is Mean Square (Error) = 5854.882. *. The mean difference is significant at the .05 level.					

Fig.1; Linearity between Each Pair of Dependent Variables (S.E., T.E.) and GROUPS\_PCK.



T.E.: Teacher Effectiveness, S.E.: Self-Efficacy, PCK\_GROUP: High, Moderate and Low.